THE LIBRARY OF CONGRESS
1800

Class TR890
Book .M65

Scanned from the collections of
The Library of Congress

Packard Campus
for Audio Visual Conservation
www.loc.gov/avconservation

Motion Picture and Television Reading Room
www.loc.gov/rr/mopic

Recorded Sound Reference Center
www.loc.gov/rr/record

MOTION PICTURE PROJECTIONIST

(Fifth Year of Publication)

THE ILEX F:2.5

STANDARD ADJUSTABLE
PROJECTION LENS

SHORT FOCAL LENGTHS

A new era in screen presentation brings forth larger pictures and wider screens. "Grandeur" effects from 35mm. film are now possible for every theatre with ILEX, offering the finest short focal length lenses that the present day market affords. This is true because ILEX lenses are corrected for critical definition, maximum sharpness, brilliant illumination and flatness of field. Slop-over and incomplete covering of the screen are cared for by the exclusive ILEX adjustable feature.

For the projection equipment you use, ILEX lenses are the best . . . perfect in performance . . . faithful in service. We can furnish engineering data and interesting literature to cover your projection problems.

ILEX OPTICAL CO. ROCHESTER, N. Y.

FURNISHED IN A WIDE RANGE
OF FOCAL LENGTHS
2½" to 9"

ILEX

OPTICAL PRODUCTS OF PRECISION

ILEX OPTICAL CO.

INSIST UPON ILEX — THE LENS THAT PUTS PERFECTION IN PROJECTION

A Mancall
Publication

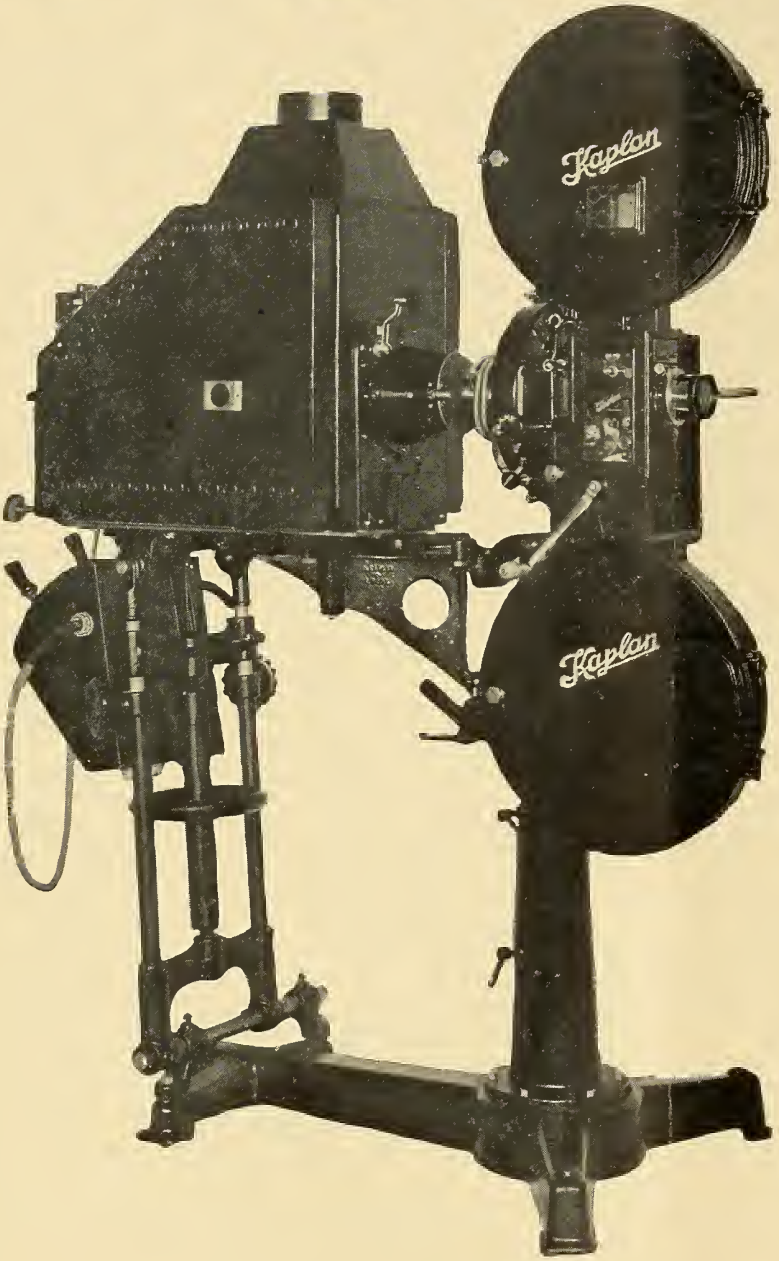
NOVEMBER, 1931

Vol. 5, No. 1
25c. per copy
$2.00 per year

TR81
M65

Kaplan

PROJECTOR



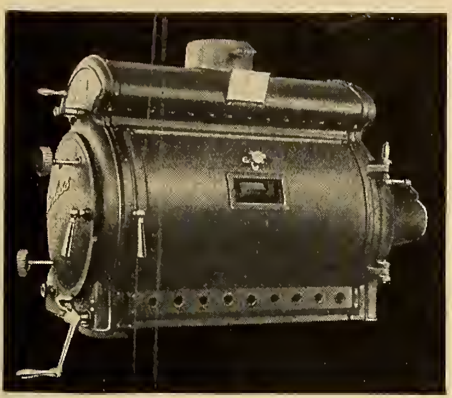
The Kaplan projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

35-7316

An Engineering Product

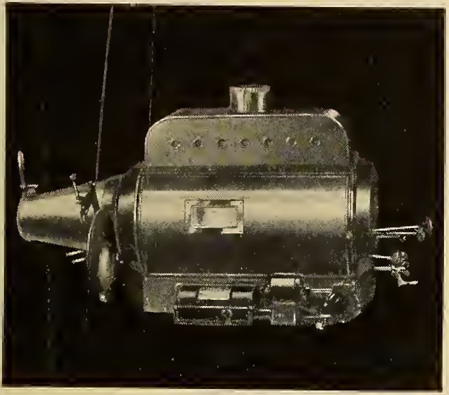
SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue -:- -:- New York City



Peerless

"The Super Reflector Arc Lamp"

DEPENDABILITY!



COMPLETELY
ELIMINATES THAT
FEELING OF
"EXPECTANCY"
FROM THE BOOTH.

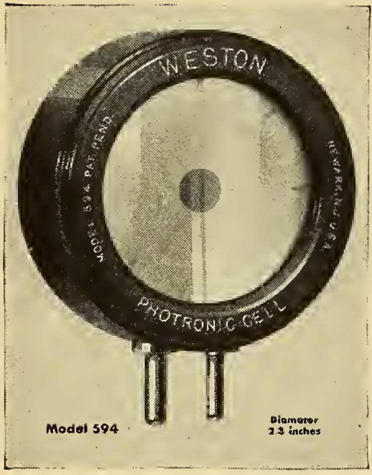
LEADING Projectionists, Engineers and Authorities of the industry agree that Peerless Reflector Arc Lamps are their "Preferred Choice." . . . Peerless has earned this enviable confidence by virtue of its inherent ability uncomplainingly to **stand up and deliver** under any projection requirement; and to do it most economically, with greater performance satisfaction, at a minimum upkeep expense and by far less mechanical attention. . . . You can always depend on Peerless.

Why Speculate?

Manufactured by

J. E. McAULEY MANUFACTURING COMPANY
552-54 West Adams St., CHICAGO, ILL., U. S. A.

ANNOUNCING *THE NEW*



WESTON

PHOTRONIC CELL

In use and construction, the Weston PHOTRONIC CELL is different—utterly simple—and low in cost.

Revolutionizing in operation, amazing in performance, the PHOTRONIC CELL reduces light sensitive cell applications to a new simplicity. Reliability increased . . . new fields opened . . . present developments advanced. The PHOTRONIC CELL sets an entirely new standard of performance. *Write for Circular YY.*

●

OUTSTANDING FEATURES

- Highly sensitive.
- High current output (approx. 5 milliamperes in direct sunlight—one microampere per foot-candle).
- Operates relays directly.
- Unlimited life.
- No drifting.
- No deterioration.
- No batteries.
- No dark current.
- No readjustments of circuit.
- Non-microphonic.
- Withstands direct sunlight.
- Not easily damaged.
- Nothing to replace.
- Low in cost.

WESTON

ELECTRICAL INSTRUMENT CORP.

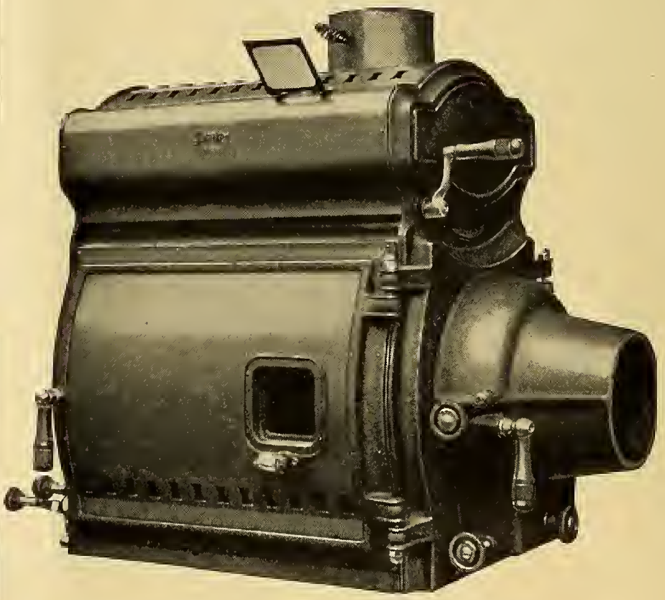
617 FRELINGHUYSEN AVENUE . . . NEWARK, N. J.

Brenkert

SUPER HIGH INTENSITY PROJECTION LAMP

is consistently producing superior screen results in many of the finest theatres from coast to coast.

Arrange with your nearest independent supply dealer for a demonstration in your theatre.



Ask Any User

A Brenkert PRODUCT

Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.

Engineers & Manufacturers

ST. AUBIN AT EAST GRAND BLVD., DETROIT

Fundamentals of Projection

SMALL AREA of light source is essential to the projection of a clear, sharp image on the screen. The crater of the carbon arc, just a few millimeters in diameter, is the ideal source of light.

HIGH INTRINSIC BRILLIANCY is required of this minute area of light—sixteen million times the high intensity of screen illumination demanded by the critical patron. National Projector Carbons afford an intrinsic crater brilliancy rivaling that of the sun at zenith.

STEADY LIGHT is equally essential to satisfying projection. Extensive research and years of experience have enabled National Projector Carbons to supply the steady, white light that is a source of satisfaction to both projectionist and patron.

Two satisfied patrons pay for the
National Projector Carbons
used at each performance.

NATIONAL
PROJECTOR CARBONS

. . . Sold exclusively through distributors and dealers. National Carbon Company will gladly cooperate with the producer, exhibitor, machine manufacturer or projectionist on any problem involving light.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division , Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York Pittsburgh Chicago San Francisco

New Projection Efficiency

SUPER Cinephors are true anastigmats. They improve the image quality by overcoming astigmatism, spherical aberration and chromatic aberration. Pictures projected with Super Cinephors have maximum sharpness of detail, contrast between blacks and whites and brilliance of illumination.

50% more light is concentrated on the film by the new B & L Condensing System. This overcomes loss of light due to reduction of reflecting area of perforated screens. For finest projection use this condensing system with Super Cinephors.

Catalog E-16 describes them and gives valuable information to the projectionist. Send for your copy now. Bausch & Lomb Optical Co., 680 St. Paul Street, Rochester, N. Y.

TO GREATER VISION THROUGH OPTICAL SCIENCE BAUSCH & LOMB

BAUSCH & LOMB

WALKER SOUNDSCREEN

The Aristocrat of White Screens

INSIST ON THE BEST

Technicolor Victor in 10-Year Litigation

A patent embracing 234 claims covering the production of pictures in color, and acquiring rights claimed by many contestants since 1921, has just been issued to Dr. Leonard T. Troland of the Technicolor Motion Picture Corporation. Dr. Herbert T. Kalmus, president, declared that in his opinion, the claims granted will give Technicolor control over most, if not all, of the various methods of manufacturing color films employed by other companies.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of

MOTION PICTURE PROJECTIONIST,

published Monthly at New York, N. Y., for Oct. 1, 1931.

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Charles E. Brownell, who, having been duly sworn according to law, deposes and says that he is the Editor of MOTION PICTURE PROJECTIONIST, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by Act of August 24, 1912, embodied in section 411, Postal Laws and regulations, printed on the reverse of this form, to wit:

1. That the names and address of the publisher, editor, managing editor, and business manager are: Publisher, Mancall Publishing Corp.; 7 West 44th St., New York City; Editor, Charles E. Brownell, 7 West 44th St., New York City; Managing Editor, none. Business Manager, Boone Mancall, 7 West 44th St., New York City.

2. That the owner is: Mancall Publishing Corporation, 7 West 44th St., New York City. Olga Mancall, 323 West 90th St., New York City. Boone Mancall, 7 West 44th St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is . . . (This information is required from daily publications only.)

CHARLES E. BROWNELL,
Editor.

Sworn to and subscribed before me this 26th day of September, 1931.

GEORGE J. JEDLICKA,
Notary Public.
N. Y. County Clerk's No. 223.
Reg. No. 3-J-145.
[Seal] (My commission expires March 30, 1933.)

MOTION PICTURE PROJECTIONIST

November, 1931 Vol. 5, No. 1

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* R. H. McCullough, *Sound Projection;* Harry Rubin, *Improvement;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S.; twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue.
Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879. Additional entry at New Brunswick, New Jersey.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Mortimer Glancoff

Editorial & Advertising Office
7 West 44th St.
New York City.

Dr. Christy Joins G-M Labs.

G-M Laboratories, Inc., of Chicago, manufacturers of the Visitron Photoelectric Cell, announce the recent appointment of Dr. Andrew Christy to its engineering research staff. Dr. Christy received his degree in physics in 1928 from the University of California at Berkeley. In 1928 and 1929 he was engaged as research associate at the same institution. From 1929 to 1931 he was associated with Professor R. S. Mulliken at the University of Chicago in research on molecular structure.

Dr. Christy's new duties will be in the field of photoelectric phenomena, enlarging the theoretical and experimental studies that have been in progress during the past six years in the company laboratories.

Dr. Christy's services, it is claimed, will materially augment the company's program of research for further improvement in its products, which are now quite favorably known in the talking picture and television industries as well as experimental laboratories throughout the country.

EVERYBODY BENEFITS . . .

. . . by the introduction of Eastman *Super-sensitive* Panchromatic Negative. Actor, director, camera man, laboratory worker, exhibitor, audience . . . right down the line, definite and substantial advantages are derived from this major improvement of 1931. And the producers and exhibitors in whose pictures it is used benefit most of all . . . in better photography, and better pictures in general. Eastman Kodak Company, Rochester, New York. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN *SUPER-SENSITIVE*
Panchromatic Negative, *Type 2*

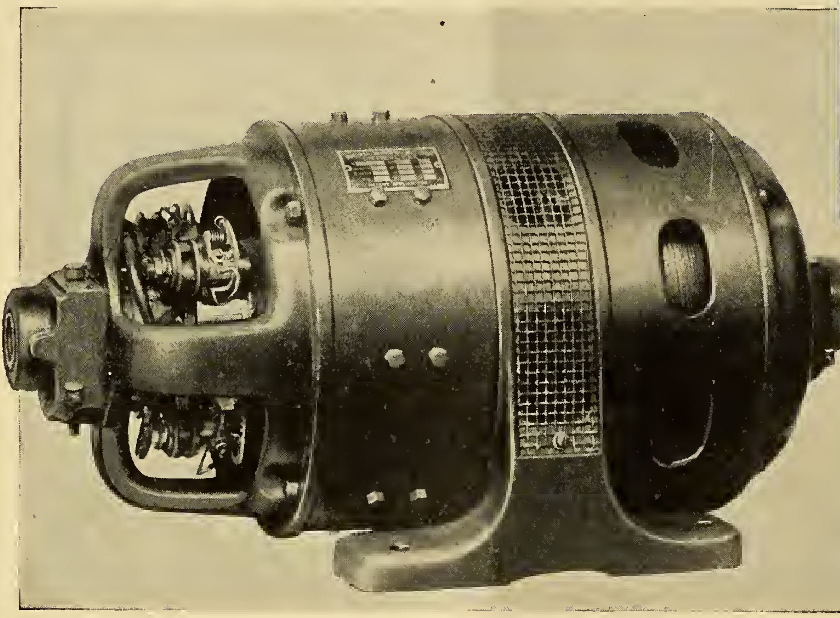
F. S. C.
OPTICAL CROWN PLATES
For enclosing Portholes of Projection Booths
PRECISION SURFACES
NO DISTORTION

S. O. G.
"IGNAL" CONDENSERS
Made of extra heat resisting Optical Glass
ALL SIZES
ALL FOCAL LENGTHS

Sole Distributors
FISH-SCHURMAN CORP.
45 West 45th Street New York City, N. Y.

THEY KEEP A-RUNNING

ROTH ACTODECTORS



20/40 to 100/200 Ampere 2-Bearing Actodector

ROTH
ACTODECTOR
CONTROL
PANEL

ECONOMY OF OPERATION

Roth Multiple Arc Actodector Generators are designed by scientific proportioning to operate at an exceptionally low voltage. This reduces loss in ballast resistors, field and armature. Laminations are of non-ageing and low loss silicon steel. The frame is rolled steel. These features increase efficiency.

Continuous, brilliant screen illumination of uniform intensity is assured, even during change-over. Any number of arcs can be carried within the ampere ratings of Roth Multiple Arc Type Actodectors. They are especially desireable in connection with sound projection equipment. The sizes range from 20 to 600 amperes . . . Furnished in 2- and 4-bearing types.

ROTH
Emergency Lighting Plants
are giving thoroughly dependable protection in many of the largest circuit and independent theatres.

ROTH BROTHERS AND CO.

Division of Century Electric Company
1400 W. Adams St. Chicago, Ill.
Distributors and Offices in all Principal Cities

ACDC-12

DIRECT CURRENT MOTORS AND GENERATORS

ROTH

MOTOR GENERATOR SETS AND ROTARY CONVERTERS

As The EDITOR *Sees* IT

¶ *Retrospect and Prospect*

WITH the present issue, THE MOTION PICTURE PROJECTIONIST enters the fifth year of its service to the man in the projection room.

Dedicated to the needs of the practical worker in picture and sound presentation, the purpose of the publication has been and is to serve as a medium for the dissemination of useful and practical information. More, it is to provide a forum, accessible to every earnest worker, for discussion of subjects pertinent to its field.

In this manner only can it attain the full measure of its usefulness, which is to convey the views of the research worker and the engineer, the scientist and the inventor, to the projectionist, who has, or who ultimately will have, in his charge the products of their minds and hands, and in exchange, to place before the former, the reactions, suggestions and constructive criticism of those men, who by virtue of practical experience, are best qualified to pass judgment upon their achievements.

Technical in its scope, the magazine must not and cannot, however, lose sight of the fact that to serve the greatest number, it must first and always be practical. Its concern, therefore, is not so much with the theories and hypotheses of advanced research, but with facts as they must be known and utilized in the tasks of the day.

This policy is founded on an interdependence embracing the workers in every branch of the industry. The need for close cooperation on the part of everyone concerned was never greater than it is today. Probably the outstanding accomplishment of the recent convention of the Society of Motion Picture Engineers may be written as the official recognition of this fact.

But cooperation among the members of a world-wide industry, such as ours, requires more than a mere statement of good intention and the will to serve. It calls for more than an occasional convention and a series of projectionists' seminars. It renders imperative the necessity for a medium for the exchange of ideas, which is recognized and accessible to all.

That such a medium may be found in THE MOTION PICTURE PROJECTIONIST, is for others than ourselves to say. But that this magazine has remained steadfast to its purpose, is attested by the increasing success which has attended its publication. Its progress has been continuous and undeviating, until today it is universally recognized as one of the foremost magazines in the field of projection. For what may exist in the way of achievement, the credit goes to the high type and intelligent discrimination of its authors and of its readers.

We now enter our new year. What it may bring forth, no man can say. One fact is obvious. The times are rife with new development. The man who wishes to keep pace with progress must have his wits about him. It will not suffice that he perform competently the work of today, he must anticipate and envision the task of tomorrow.

For the attainment of this end, the projectionist has open to him several channels by means of which the desired information may be acquired. He has daily contact with other workers in his chosen field. He has a continuously increasing market of scientific books. And he has his technical and trade publications.

Of these, the last are by far the most important. Information acquired through personal contact, while useful, is all too frequently misleading and unreliable. Knowledge derived from books, if they are well chosen, may be authoritative and enduring, but much is lost in that such volumes are usually the product of a single writer, and require considerable time for their preparation and publication. It is therefore, to the technical journal that the earnest student must turn for the accomplishments of the present and the promises of the future.

With this as its credo, and a keen appreciation of its duty to its readers, THE MOTION PICTURE PROJECTIONIST, in the light of its past performance, can well afford to anticipate with confidence its coming year.

¶ *The Passing of a Pioneer*

IN the death of Thomas Alva Edison, the world in general, and the motion picture industry in particular, mourns the loss of one of its greatest men.

While modern research tends to show that the motion picture is not the invention of an individual, there can be no doubt in the mind of anyone that the contribution of Mr. Edison will loom large in the history of the industry. His invention of the kinetoscope in 1887 translated at one stroke, what had hitherto been to all intents and purposes a scientific curiosity, into the sphere of practical commercial achievement. Despite his diversified scientific and commercial interests, Mr. Edison subsequently found time to associate himself actively in the affairs of the industry for many years.

Viewed in the broader aspect of his total contribution to welfare of the human race, it is difficult for the mind of the average person to encompass the vast scope of his activities, or to appreciate the full measure of his accomplishments. We have been living too near to the man. It remains for the future historian to assign to him his rightful place among the great benefactors of mankind.

CHARLES E. BROWNELL.

The Use of Resistance in Arc Circuits

By WILSON G. BOYDEN

The use and application of resistance in arc circuits is a subject which is of concern to every worker with projection equipment. In presenting Mr. Boyden's article on the subject, the first installment of which appears in this issue, we have the assurance of securing our information from an authoritative source. The author is an electrical engineer and a member of the Engineering Staff of the Ward Leonard Electric Company. — THE EDITOR.

Part 1

A REMARKABLE advance is evident in modern projection equipment as compared with that used in the past. Much of this has been necessary to keep pace with the development of sound, color photography, the use of wide screens and the construction of larger theatres. The advance has made possible the continuous improvement in the quality of the pictures shown on the screen. It has been due in part to improved lamp houses, projector carbons of increased capacity and the use of higher amperages in the arc circuits in order to increase light intensities on the screen.

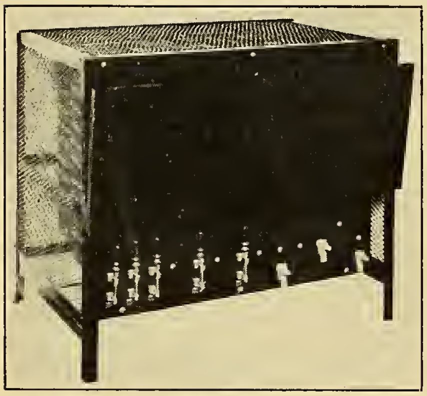


Fig. 1

The control of the current in the arc light circuit and the stabilization of the arc must be provided in the form of resistance. Every projectionist should have an understanding of the use and problems presented in applying resistance to arc circuits.

Resistance Used as Ballast

Two carbons set up in a standard lamp house connected across a line supplying current at a constant voltage without a ballast would not furnish a satisfactory source of light. An electric arc has what is known as negative coefficient of resistance so that the volt-ampere characteristic does not follow Ohm's law. In other words, the voltage of an arc in a circuit without ballast decreases as the current is increased, until the voltage of the arc is not sufficient to sustain the current between the carbons. Then, the arc "snaps" out.

To overcome this, ballast in the form of resistance is connected in the circuit to limit the current and thereby stabilize the arc by maintaining a constant arc voltage. An arc stabilized in this manner provides a steady source of light. The resistance also serves a useful purpose in limiting the amount of current that flows when the arc is struck by shorting the carbons. Without this resistance in the circuit, the current drain from the supply circuit would be excessive. In certain applications, resistance is added, to that necessarily required to stabilize the arc, in order to provide a means of dropping the supply voltage to a value suitable for the arc.

Arc Voltage

The arc voltage depends on the arc gap, the size and quality of the carbons, the position of the carbons, and the current flowing in the circuit. Due to practical considerations, it is impossible to fix definite values of arc voltage within small limits, but a recent article in MOTION PICTURE PROJECTIONIST has given some working values for projection arcs. For immediate reference these are listed in Table A.

In comparing the voltages in the table with those obtained by actual measurement consideration should be given to the following statement of the authors: "Arc voltage does not afford a reliable basis for adjusting the relative position of the carbons since it is possible to obtain the normal arc voltage for a given current with the carbons in a position which gives much less than the maximum effective light." It is, therefore, left to the skill, care and judgment of the projectionist so to adjust the arc gap and carbon position to obtain the maximum light from the arc with a given current.

Source of Current Supply

The arc circuits are supplied energy from either the direct current service mains of a company distributing electrical power or, in an AC district, from a convertor, such as a motor generator set or rectifier, which receives alternating current from the service mains and furnishes direct-current for use in the arc circuits.

In all cases, the voltage supplied may be considered as a constant, the value depending on local conditions. The values commonly met in practice are as follows: 80, 85, 90, 100, and 115 volts. In all cases, the rheostat must be designed for the actual conditions of line voltage, arc voltage, and current range under which it must operate.

Voltage Drop Across Resistance

The voltage drop in the ballast rheostat equals the difference between the supply voltage and the desired arc voltage. In order to steady the arc, the value of this drop should approximate fifty per cent of the arc voltage.

TABLE A

Voltage & Current Specifications for Various Carbon Combinations*

Type of Lamp	*Projector Carbons*	*Voltage*	*Current*
Reflector: Low Intensity	12 mm. x 8″ Cored Positive 8 mm. x 8″ Solid or Cored Negative	50-60	21-25
Reflector: Low Intensity	13 mm. x 8″ Cored Positive 9 mm. x 8″ Cored Negative	50-60	26-30
Reflector: Low Intensity	14 mm. x 8″ Cored Positive 10 mm. x 8″ Cored Negative	50-60	31-35
Reflector: Super	12 mm. x 8″ SRA Positive 8 mm. x 8″ SRA Cored Negative	52-55	28-32
Reflector: Super	13 mm. x 8″ SRA Cored Positive 8 mm. x 8″ SRA Cored Negative	52-55	32-42
Reflector: Hi. Intensity	9 mm. x 20″ H. I. Positive 5/16″ x 9″ Orotip Cored Negative	48-55	60-70
Condenser: Hi. Intensity	11 mm. x 20″ H. I. Positive 11/32″ x 9″ Orotip Cored Negative	55	75-80
Condenser: Hi. Intensity	13.6 mm. x 20″ H. I. Positive 9/16″ x 9″ Orotip Cored Negative	67-73	110-125
Condenser: Hi. Intensity	16 mm. x 20″ H. I. Positive 7/16″ x 9″ Orotip Cored Negative	73-83	150-160

TABLE B

Data Covering Arc Ballast Rheostats for 100-115 Volt Circuits.

Type of Arc	Nominal Volts	Current in Amperes	Min. Current Change Amps.	No. of Steps	Dimensions Height	Dimensions Width	Dimensions Depth
Reflector—Low Intensity	55	24-25	3	8	17″	6-¾″	15-¾″
Reflector—Hi. Intensity	55	30-90	5	13	25″	16″	18-¾″
Condenser—Hi. Intensity	60	30-120	5	19	25″	20″	18-¾″
Condenser—Hi. Intensity	70	60-150	5	19	25″	24″	18-¾″
Condenser—Hi. Intensity	75	90-180	5	19	25″	28″	18-¾″
Condenser—Hi. Intensity	75	90-210	5	25	25″	32″	18-¾″

The manufacturers of motor generators are now advocating a minimum output of 80 volts for low intensity arcs to obtain the proper ballast action from the resistance connected between the generator and the arc. It is their contention that anything less than 80 volts results in an unstable arc which is unsatisfactory for proper projection.

For the HI-Low and Hi-Intensity arc the line voltage must be considerably higher as in these lamps the current is higher. Therefore, the arc voltage also goes up and in order to get a steady arc, the line voltage must go up in proportion.

Having considered some principles covering the use of resistance in arc circuits, an explanation of the practical application in the form of resistors and rheostats may be useful. This explanation will cover the standard types in general use.

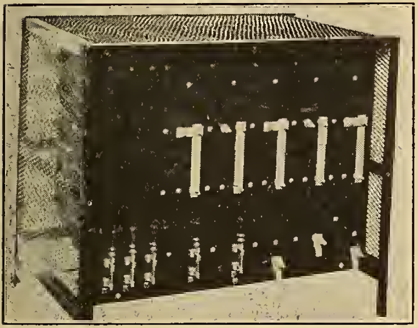


Fig. 2

Resistor Composition and Construction

The resistance for use as ballast may be furnished as a fixed resistor or as a rheostat consisting of a number of resistors with means for adjusting the amount of resistance in the circuit. Resistors have been generally used for low current applications and rheostats for both low and high current arc circuits.

The fixed resistors are supplied with a resistance element of nickel-chromium ribbon formed into a U-channel and mounted on a transite bar. This construction makes a light, compact resistance unit and the ribbon presents the maximum surface possible for heat radiation.

The alloy is non-corrosive and eliminates difficulties due to oxidation. It has a very low temperature coefficient so that the change in resistance with change in operating temperature is not appreciable. It is capable of carrying severe overloads without injury. Extra terminals are provided for adjustment of current to suit the operating requirements. The resistance unit is supported on an angle iron frame and enclosed in expanded metal.

The variable rheostats are made up using a suitable combination of resistors to furnish the specified capacity. In order to provide control in 5 ampere steps, wire bar resistors are used for three steps of 5, 10 and 15 amperes. Wire bar resistors are made by winding an alloy resistance wire, having zero temperature coefficient, in the form of a long coil. The coiled wire is wrapped on a narrow transite support, eliminating the sagging of the wire and touching of adjacent coils.

The additional resistors in the variable section and all the resistors in the fixed section of the rheostat are made of Ribohm units which are identical in size and shape. It is possible to furnish any desired capacity using Ribohm units of one size with one set of wire bar resistors.

The resistor units are mounted on a transite faceplate as shown in Fig. 3. The units are spaced by insulators so that it is impossible for adjacent units to touch. The switches for adjusting the current in 5 ampere steps are also mounted on the faceplate. The rheostat, shown in Fig. 1, is furnished with 5 switches giving 11 steps of control. The present trend is to use knife switches for control due to the large contact surface available insuring perfect contact. All the resistor circuits are connected in parallel so that the current through the switches is limited to 30 amperes.

The copper bus links, shown in Fig. 2, provide a means of adjusting the resistance of the rheostat to meet a wide range of line and arc voltage. By shunting the links across the resistor sections the voltage drop can be varied in three steps of 5 volts each. This feature is a real advantage as it enables the projectionist to adjust the voltage drop in the rheostat to suit different arc voltages and to insure the calibration of the rheostat.

The faceplate supporting the switches and resistor units is supported in a substantial angle iron frame and mesh enclosure. The live parts are enclosed and provision made at the bottom in front of the faceplate for making connections. Large studs with terminal lugs are provided for making connections. The depth of the cages used on rheostats for operation on a given voltage is the same. Table B gives the data and dimensions of rheostats for use on 100 and 115 volt circuits.

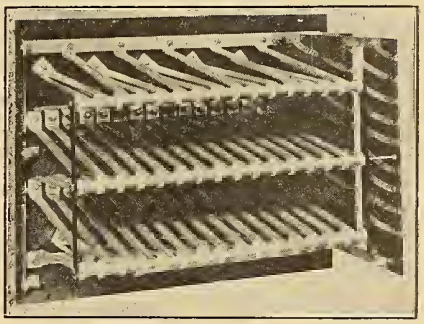


Fig. 3

(To be continued)

E. R. P. I. Awarded Decision In Default Case

Judge Clyde R. White of Minneapolis has handed down a decision awarding Electrical Research Products the full amount claimed with interest and costs, in its suit against the Peoples Theatre Company, operating the Paradise Theatre, Minneapolis. The suit was instituted because of defaulted payments on Western Electric reproducing equipment leased the theatre by Electrical Research Products. After payment was defaulted Electrical Research Products removed the equipment and brought suit to recover the amount in default. The Theatre Company set up a counterclaim for $6,100 alleging interference with its use of the equipment. Judge White's decision followed.

In his decision Judge White said in part:—

"The defendant (Peoples Theatre Co.) could not terminate this contract except upon the option of plaintiff (Electrical Research Products) . . . the sealing of the machine would not be deemed a breach of the contract, such as would warrant its termination because it took place by the mutual agreement of the parties . . . I am also clear that the contract in question is not a conditional sales contract."

Televised Motion Pictures

By D. E. REPLOGLE†

We people of today are living in a fast moving era. Those among us who are inclined to be satisfied with our present position in the scheme of things are very apt to be startled out of our lethargy to find the present has passed and our position along with it. Since the advent of television, there has been much speculation as to whether this latest development in the scientific field may be adapted to motion pictures and, if so, how the adaptation will affect the industry. In the ensuing article, Mr. Replogle describes what has already been accomplished toward the televising of motion pictures. The facts as presented should prove of interest and of service.—THE EDITOR.

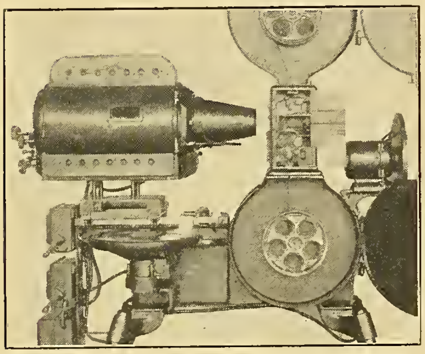


Fig. 1. Projector, Threading Side

THAT type of partnership found over and over again between established and struggling industries—a partnership seemingly between potential competitors but actually made up of complementary industries and arts—is present today in the motion picture and television situation. It marks another phase of that long cycle of collaboration in which early wireless, telephone, lamp-making, radio telephone, phonograph, motion picture and finally the television arts have freely shared in developing the numerous and diversified applications of radio technique. Indeed, by loaning freely of its art to television, the motion picture industry can give the lusty infant its real start towards commercial life.

Television is another form of synthesized entertainment. It takes the play, act, personality or news event and flashes it to a distant point to be reproduced as an animated or moving picture. By providing a microphone and a second transmission channel, the reproduced image may be accompanied by synchronized sound, thereby obtaining what is virtually a radio talkie. The foundation of commercial television rests on genuine entertainment value. Unless entertaining programs are made available to the homes of the land, there is little interest or demand for home television equipment.

We have now reached the point in television development where the program is receiving prime consideration. The technique is sufficiently advanced to provide a satisfactory vehicle for a modest program. To make that program of greatest entertainment value within the definite limitations, is our real concern.

General Principles

Before plunging into a discussion of the mechanics of picking up television programs, it may be well to lay a general foundation of television principles. First of all, television, for the purposes of the present discussion, refers to the transmission and reception of animated or living subjects via radio rather than by wire. In television practice, the image must be broken down into suitable pictorial units that can be readily translated into electrical terms for the purpose of transmission and reception. This process is known as scanning.

Today the standard scanning system is 60 lines, which means that the image is analyzed or broken down into sixty horizontal strips, each strip being translated into electrical terms representing the lights, shadows and half-tone values. While sixty horizontal strips represent the complete image, it is necessary to repeat this process at a high rate of speed if we are to obtain the optical illusion of an animated image. For this purpose the standard scanning system flashes twenty complete pictures, each represented by sixty parallel strips or lines, each second.

Necessity for Scanning

Better to understand the basic idea of television scanning, supposing we are limited in our drawing talent to straight lines of varying shade. We wish to reproduce the face on a coin. If we place that coin under a piece of paper and proceed to draw sixty parallel lines across the face of the covered coin, we soon have a fair facsimile of the face on the coin. Yet we have employed only straight lines for the purpose, with varying lights and shadows and the half-tone values between. The softness of the lead, permitting of a wide latitude of shading, and the number of parallel lines employed, as well as the accuracy with which the lines meet, determines the amount of detail obtained in the replica.

Television scanning is much the same idea. We analyze or scan the image to be transmitted, by means of a beam of light, which sweeps the field in sixty horizontal lines. The varying lights and shadows are translated into corresponding electrical terms by one or more photo-electric cells. These electrical terms are amplified hundreds of thousands of times and impressed on the carrier wave flung out by the transmitter. Whereas in sound broadcasting the electrical terms average between 50 and 5000 cycles for good musical quality, in television broadcasting the electrical terms or frequencies range between 30 and 30,000 or more cycles. Consequently the television transmitter, with its associated amplifying equipment, must be constructed with far greater care.

Lower Wave Lengths Used

The television signals, usually transmitted on lower wave lengths than the broadcast band, are intercepted by means of a special receiver. Not only must the receiver tune in the lower wave lengths, but it must admit the considerably wider signal used for television purposes. The signal is amplified, detected and amplified again. If passed on to a loud-speaker, it has a characteristic buzz-saw sound of rising and falling pitch. Usually the television signal is tuned in by means of a loud-speaker response, after which the receiver output is shifted to the radiovisor, or picture reproducing device.

The radiovisor utilizes a sensitive and highly responsive light source, which translates the amplified television signals into varying degrees of luminosity. The light from the television lamp is projected by means of a scanning disc and lens system on to a transluscent screen, so that a spot of light is all that is actually on the screen at any given moment. The scanning disc with its spirally arranged holes corresponding to those at the transmitting end, causes the spot of light to weave sixty horizontal lines twenty times per second in perfect step with the transmitter, thereby rebuilding the twenty strips used in analyzing the original image. The spot of light appears as a glowing pattern of lights and shadows, due to the persistence of vision, just as the motion picture screen provides the illusion of animated pictures whereas a succession of still pictures are actually being shown.

Perfect Synchronism Required

It will be noted that the transmitting and receiving scanning systems must remain in perfect step. Obviously, the spot of light at the receiving end must be at the same point in the scanning cycle as the spot at the transmitting end. The synchronizing means, whereby to keep transmitting and receiving scanning systems in perfect step, takes on various forms. The simplest is the use of synchonous motors operating on a common A. C. power system, since the driving power at both ends is virtually geared by the frequency.

---

†Vice-President, Jenkins Television Corp.

Where transmitter and receiver are not utilizing a common A. C. power system, it is possible to make use of a predominant frequency in the carrier wave, which is filtered out, amplified and utilized to actuate an auxiliary motor which accelerates or retards the main motor ever so slightly so as to keep the scanning disc in step with the transmitter. Since standard 60-cycle A. C. systems are almost in perfect step, very little power is required for the necessary acceleration or braking of the receiving scanning disc for perfect synchronism.

Two Types of Pickup

So much for just the basic principles of television. Returning to program considerations, there are two broad classes of television programs, namely, the direct pick-up and the film pick-up. As the terms imply, the first deals with picking up living subjects either in the studio or outdoors. The second deals with picking up motion picture subjects recorded on film.

Direct pick-up, because of inherent difficulties, has been developed more slowly than film pick-up. Until quite recently, the best television results have been obtained with carefully selected films ranging from the simplest black-and-white or silhouette studies to regular feature pictures. Within the past few months, however, the direct pick-up art has been greatly advanced by improved and refined pick-up apparatus, notably the Jenkins television camera in conjunction with a flood-lighted subject, in place of the flying spot illumination with banks of photo-electric cells.

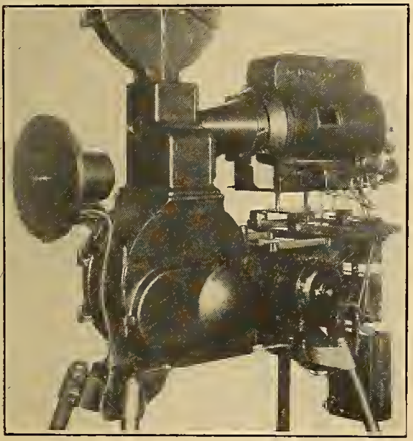


Fig. 2. Projector, Drive Side

The latest camera is not unlike the motion picture camera. The image is focused by means of a wide aperture lens on to an enclosed scanning disc, which in turn breaks down the image into strips for the photo-electric cells within the camera. The cameraman can tilt or swing the camera, while following the action in a view finder which is, in reality, a monitor radiovisor, reproducing the picked up image exactly as it is being sent to the transmitter.

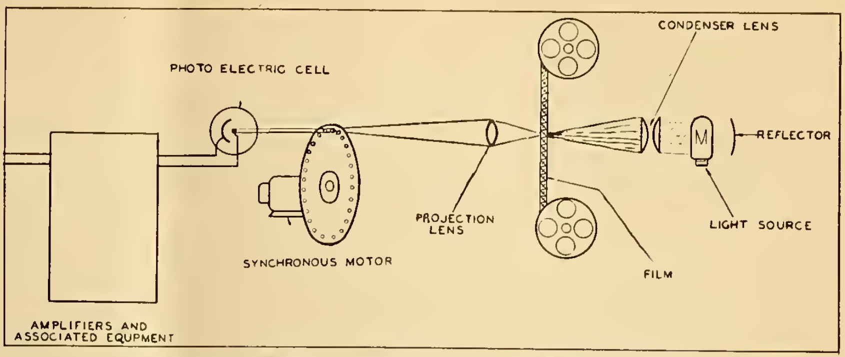


Fig. 3. Graphic Illustration of Pick-up Process

Conditions Encountered

With the direct pick-up system we encounter the general conditions familiar to the cameraman. We must have a suitable subject which will provide the desired impression on the sensitive recording means, whether it be photographic emulsion or photo-electric cell. We must have proper lighting so as to secure pleasing lights and shadows. We must have suitable backgrounds. Then there are other requirements such as dressing rooms, properties, carpenters, electricians and so on, all raising the cost of programs to the point where syndication or widespread distribution of programs is economically essential.

Unfortunately, there is no available method of transmitting television signals over long wire lines for network syndication. The wide range of frequencies required for pictorial detail cannot be handled over existing telephone lines. Hence the direct pick-up program is limited to a near-by transmitter, and its economics must be worked out on that basis.

The direct pick-up has obvious and undeniable advantages. It permits of presenting timely speakers, entertainers, personalities. Ultimately, it must place visual news and sporting events on the air. For the present, however, it is definitely limited to the non-syndicated type of program with its economical restrictions. Moreover, change of locale including scenes impossible of televising by direct pick-up, must be presented in some other manner.

Film Pick-Up

Turning to the film pick-up, we find many immediate advantages to recommend it as the very backbone of the television program. First and foremost, the film pick-up lends itself ideally to syndication. Film produced anywhere, whether in studio or outdoors, can be printed and distributed to any number of associated transmitting stations. Just as the electrical transcription or recorded program brings the finest entertainment to the small broadcaster, so does film bring the finest television entertainment to the remote broadcaster. It takes the place of an elaborate and costly studio, as well as an expensive television studio staff and talent. Properly timed, the program can be simultaneously broadcast to a nation-wide audience through a plurality of transmitters. What with air transport and record-breaking flights, the time element in distributing such films is no longer the great drawback it once was.

From the standpoint of television technique, the film pick-up permits of excellent detail with the simplest equipment. The subjects may be properly lighted and filmed for television transmission, in the usual motion picture studio or outdoors. In this event the equipment, personnel and experience are already available and add no crushing burden on the infant television industry.

Results Very Satisfactory

With satisfactory film available, the film pick-up in the television transmitting station faithfully translates the pictorial values into beautifully modulated signals. In the latest Jenkins film pick-up apparatus the image is considerably enlarged and then scanned by a large disc, permitting of far greater precision than in the former practice of scanning the film itself. This system makes possible the use of more lines for the scanning system, which in turn spells finer detail. Also, more light can be passed through the film. It is now possible to employ a 240-line scanning system, which provides pictorial detail comparable with the screen pictures obtained with low-priced home projectors. With present direct pick-up, it is difficult to go beyond 120-line scanning.

The film pick-up comprises a powerful light source, the film itself, a scanning disc and the photo-electric cell, together with the necessary optical system. The light passes through the film and an enlarged image is thrown on the scanning mechanism which breaks it down into the sixty lines or strips. The film moves continuously through the gate, and not intermittently as in screen work. Each hole of the scanning disc traces a line across the film, while the movement of the film serves as the line spacer.

Sight and Sound Programs

Sound films lend themselves particular well to sight-and-sound broadcast programs. So far, the television pick-up makes use of sound-on-disc films, with the disc turntable driven by a flexible shaft. In the near future, we shall be handling sound-on-film subjects by the conventional means, making available for television programs the growing library of "talkies." The sound accompaniment is as desirable in television as in motion pictures, if not more so, since it makes up for the shortcomings of the reproduced image.

Transmission of Detail

It is surprising even to television workers to note the amount of detail that may be transmitted by means of a properly designed film pick-up. With our latest equipment, such as is installed in the WGBS—W2XCR sight-and-sound broadcasting studios on Fifth Avenue, New York City, standard motion picture films are handled with excellent results. Even with several figures, intricate backgrounds and subtle rather than broad action, the pictures are transmitted over the air and received with sufficient detail for ready understandability. Proper selection of film subjects of course assures the best possible images over the air.

Television is the projection of stage and screen out into space for the purpose of reaching an unlimited audience. In the case of the direct pick-up, the performers and speakers must face the microphone and photo-electric cells which are the ears and the eyes of the audience out beyond the four walls of the studio. In the case of film pick-up, the performers face the usual camera and microphone; and the film, projected on a scanning mechanism, is viewed by an electric eye so that it may be flashed to the invisible audience.

Radio gave the heretofore silent screen its voice. Today the motion picture industry can reciprocate by giving the infant television art its basic program material. In this manner can the television industry most rapidly replace its experimental programs with programs of genuine entertainment value, available to an audience throughout the land.

A New Departure In Spotlights

By HERBERT A. KLIEGL

In the article which follows, Mr. Kliegl describes a new type of heavy duty booth spotlight, which has recently been placed on the market. The unit possess many novel and attractive features, such as positive color slide control, unique construction which permits of effective air cooling, and special shutter controls. The author is vice president and treasurer of Kliegl Brothers Universal Electric Stage Lighting Company. — THE EDITOR.

THE booth spotlight of today must not only be able to pick out an individual or a group, but must also permit the flooding of the entire stage and orchestra pit, be adaptable for special lighting effects, give perfect colored light, and above all permit the accomplishment of all of these things quickly and with a surety of action and a minimum of effort.

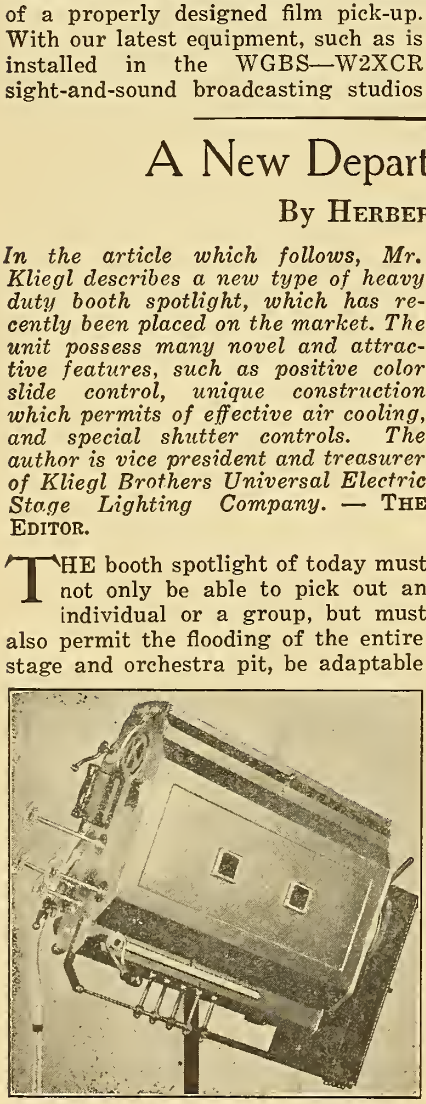


Fig. 1. The New Spotlight

The unit described in the following paragraphs answers the requirements of the projectionist of the modern theatre, in that it possesses all of these desirable qualities combined with a greater ease and flexibility of control than ever before offered. It provides in a single unit, everything that may be needed in the operation of a projector—having all the controls centralized, and fitted with every accommodation that makes for speedy, convenient, and easy operation.

The Arc Equipment

The spotlight is equipped with a 100 ampere arc lamp, recommended for any distance up to 150 feet. It gives an intensely brilliant, soft-edge spot, or a flood of light ranging from a four foot spot to a seventy foot spread at the afore-mentioned throw. The outfit operates at high efficiency. It is furnished with accessories for white lighting, color lighting, framing, fading, and all standard effects. It is especially applicable in theatres for spotlighting and floodlighting performers, stage settings, organists or the entire personnel of the orchestra pit with clear or colored light, and also for the projection of special stage lighting effects from the motion picture booth.

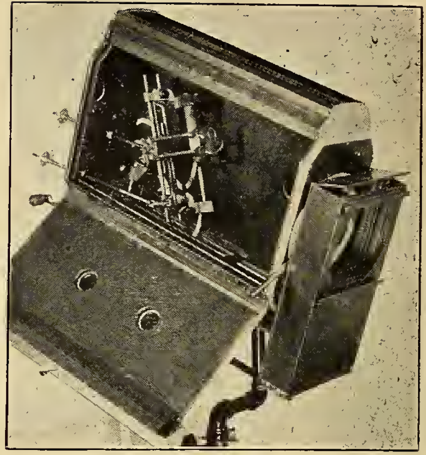


Fig. 2. Interior View

Lamp House Features

The lamp housing, while it resembles in general appearance the types in ordinary use, is really quite different in construction, and embodies a newly patented arrangement which prevents the outside walls of the housing from becoming unbearably hot to the touch, as is usually the case with heavy current arc spotlights. A double walled type of construction is used, which permits a stream of air to pass constantly between the inner and the outer wall, thus preventing the outer wall from becoming hot.

It is important to note that this air never enters the hood itself, but is confined to the area between the walls. The heat of the arc is dissipated rapidly by another air stream which enters the bottom of the lamp housing and passes directly through and out of top of the housing, without being deflected by baffles. The special, patented air vent, in the top of the housing, permits the accomplishment of this direct draft without light leakage.

The lamp housing is fitted with an 8″ lens and a large self-closing spring door on one side, permitting easy access to the interior for changing carbons. A spring trap-door in the bottom of the housing allows for the removal of dirt and carbon particles, and several peepholes, fitted with ruby glass, permit inspection of the arc in operation.

The arc lamp is of the hand feed type of improved design, 100 ampere rating, with rear controls that permit smooth and speedy adjustments of the arc and carbon in every possible way that may be required for perfect operation. The bottom carbon has a right and left adjustment as well as an adjustment which brings the carbon frontward or backward, with respect to the upper carbon, for correct alignment.

(*Continued on page* 16)

Photoelectric Cell Theory and Construction

By R. J. STIER†

The photoelectric cell is at once one of the most interesting and one of the most important factors in the reproduction of sound from film recordings. Without it, the sound film as we know it today would be a dream of the future instead of a reality of the present. In choosing the device as the subject of his article in this month's issue, Mr. Stier has selected a topic which is of concern to every worker with projection equipment.—THE EDITOR.

EVERY material is sensitive to the action of light. It does not matter in what state the material be—solid, liquid, or gas. This statement, from the viewpoint of the practical man, is true only from a relative point of view, since most liquids and solids, especially the metals, respond only to the extremely short X-rays or ultra-violet rays. Only a few of the metals respond to rays of light of the length of the infra-red or the visible light portion of the spectrum. These exceptions are the alkali metals of which sodium, potassium and caesium are excellent well known examples. These alkali metals are exceedingly sensitive to those light rays visible to the eye. Their sensitivity may extend into the infra-red region of the light spectrum.

A type of photocell widely used in sound projector equipment today consists of a glass envelope containing within itself a curved cylindrical sheet or plate, termed the cathode, having in front of the cathode a vertical wire, called the anode. On the cathode is placed, during the processes of manufacture, a thin film or coating of caesium which has the property of emitting electrons when exposed to light.

The number of electrons emitted by the cathode, under the influence of the incident light, varies directly as the intensity of the incident light. In other words the number of electrons released from the cathode is proportional to the quantity of light falling upon the cathode. This relationship is true only when the wavelength of the light remains constant, that is, when its *color* remains unchanged.

The Caesium Cell

Of the photocells commercially available, the caesium cell shows a greater sensitivity in ordinary usage than does the potassium or sodium cell. This is true because caesium itself is sensitive to the red and the infra-red portions of the spectrum (an exciter lamp is a very rich source of these rays) while the potassium and the sodium cells are most sensitive to the violet and the ultra-violet portions of the spectrum (in which the ordinary exciter lamp is comparatively deficient).

When the light from the exciter lamp strikes such a cell electrons are emitted from the cathode very much as electrons are emitted, by thermal action, from the hot filament of the vacuum tube. In the case of the photocell, as in the case of the vacuum tube, an EMF is connected in series with the anode and the cathode so "poled" that the anode is positive with respect to the cathode. When light strikes a photocell so connected the electrons released will be attracted from the cathode (from which the light has released them) to the anode. They will then pass through the battery and return to the cathode thus completing the circuit. If a resistance be inserted in this battery line a potential difference will exist across the resistor terminals due to the voltage drop developed within the resistor.

The Coupling Device

As is common in sound projection practice a transformer's primary winding is substituted for the resistor mentioned above and the variation in current flowing through the transformer winding, connected in series with the photocell, is "repeated" across the transformer, hence a similar voltage appears at the secondary terminals of the transformer. Since the amount of current passed by the photocell varies in direct proportion to the amount of light falling upon the photocell cathode, it follows infallibly that the current passing through the transformer winding, connected in series with the photocell, varies directly as the amount of light reaching the photocell cathode. From this it is but a simple step to the conclusion that the voltage appearing at the transformer secondary terminals is a direct function of the varying amount of light incident to the photocell cathode.

Introduction of Gas

Up to this point we have discussed only a simple cell; one containing an anode and a light sensitive cathode presumably operating in a vacuum. The number of electrons emitted under such circumstances is very small, however. So small, in fact, that any means of increasing the electronic flow is justified. This may be accomplished by means of a phenomenon known as "ionization by collision" or "gas amplification."

Gas amplification is accomplished by filling the cell with an inert gas, such as argon, at very low pressures. The cell then becomes a gas-filled cell. All matter, including the gas with which the cells are filled, is composed of molecules. Molecules are the smallest indivisible quantities of any material. This definition includes, of course, the inert gas with which the cell is filled. The gas molecules in turn are composed of equal numbers of electrons and protons. Electrons and protons attract each other with tremendous force, when one considers their infinitesimal dimensions, and repel each other with like force.

Movement of Electrons

The electrons, in moving through a definite space or region constitute the phenomenon we know as an electric flow, or more familiarly, an electric current. In the photocell, the battery exerts a force on these electrons in the direction of the anode. The light releases the electrons from the cathode and, under the accelerating effect of the force exerted by the anode potential, the speed of the electrons is increased as they travel toward the anode. Relatively few of the collected electrons reach the anode without having struck several molecules of the inert gas introduced into the cell.

If the electrons strike the gas molecules with sufficient force they may disrupt the gas molecules into their constituent electrons and protons. However, since protons are approximately 1,800 times as heavy as electrons the latter are usually forced out from the gas molecule by force of impact. From one to five or more electrons may be removed from the gas molecule, the actual quantity depending upon the velocity with which the traveling electron strikes the molecule.

Factors in Gas Amplification

If the gas be introduced at ordinary atmospheric pressures, the molecules of gas are spaced relatively closely and the average distance between molecules is not great enough to permit sufficient electron acceleration to knock out additional electrons by such bombardment. If, however, the cell be filled with gas at a relatively low pressure (as is done) the electrons have an excellent opportunity to accelerate sufficiently before colliding with the gas molecules to release, by force of impact, several additional electrons from the gas molecule so struck. We then have many more electrons than were originally released by the incident light, which are collected by the positive anode, and a number of ions or remains of molecules charged due to their excess proton content.

"Gas amplification" is the product of many variable factors the more important of which are these:

1. The pressure of the gas. Lower

---

†Engineering Department, RCA Photophone Inc.

gas pressure results in a greater relative spacing between molecules and the electron may then attain a greater velocity in this spacing which results in a greater impact of collision between the electron and the molecule. On the other hand the gas pressure may not be too low for under these circumstances the relative scarcity of molecules results in a greater percentage of electrons striking the anode without colliding with the gas molecules. Average suitable gas pressures are about 0.01 mm.

2. The nature of the inert gas. Some gas molecules ionize at lower potentials than others; the magnitude of impact required to disrupt the molecular structure of the gas molecule varies accordingly.

3. The voltage of the photocell polarizing potential. The potential gradient existing within the cell determines the acceleration of the emitted electron. If the gas is under greater pressure than that ordinarily considered optimum a greater polarizing potential is required to accelerate the electrons sufficiently, in the smaller distance, in order that they may strike the molecule with the same impact as before.

The electrons released by collision are attracted to the anode, as are the electrons emitted from the cathode. Similiarly they accelerate and strike other molecules with sufficient force to disrupt additional electrons which in turn travel towards the anode only to strike still other molecules en route. Thus the effect of the electronic bombardment of the gas molecules is seen to be cumulative. A stable operating point is reached when the polarizing potential is properly adjusted, the light source is not too intense and the gas pressure is not too great.

Under proper conditions of polarizing potential, light source and gas pressure, the ionized increment added to the electronic stream is directly proportioned to the electronic emission of the cathode and hence to the light source. If any of these values is excessive, however, the ionization may proceed to the point of saturation producing the familiar glow caused by an excessively ionized condition within the cell. This glow is harmful to the cell and should be stopped as soon as possible after its establishment.

Principle of Photo Conduction

No discussion of photocells is complete without reference to cells operating by virtue of a principle known as photo conduction. Photo conduction is the property any material may possess to change its *electrical resistance.* It is caused by the action of incident light. Selenium is a notable example of an element possessing photo conductive properties. Under any conditions selenium is a very poor conductor of electricity but under the influence of light the resistance of the selenium decreases and permits an increased current to flow. Selenium has a sluggish response characteristic—that is, its response to changes in the amount of light falling upon it is slow as compared to the practically instantaneous response of the true photo electric cell—hence its use, at present, in sound projection work is not most desirable.

Selenium, in its ordinary forms, lacks the ability to "follow" actual changes in light intensities occurring in a modulation of the original incident light (such as those caused by the passage of a sound track in the sound gate) and its inability to follow these changes is more apparent with increase in frequency. While the cell may be used for sound projector work its use is not desirable because of its high frequency cut-off. Later work has developed structures of selenium cells which have less lag than the earlier types.

Thallium Oxysulphide Cell

There has been developed one additional type of photocell conductive, which uses a compound called thallium-oxysulphide in place of the more familiar selenium. Thallium-oxysulphide is quite sensitive to the red and infra-red rays, in which the ordinary exciter lamp is quite rich, and has a favorable lag characteristic. It is used in one system of talking picture equipment. The cell requires the use of a special light filter to reduce the rate of speed at which the sensitive sulphide changes to the insensitive sulphate.

Cells operating upon the photo voltaic principle are available on the commercial market. Photo voltaic cells operate upon the principle of creation of an electromotive force within an electrolytic cell when an electrode or the electrolyte is exposed to illumination. Most photo voltaic cells use a construction employing a sensitive electrode rather than a sensitive electrolyte. Silver halides and cuprous oxide are most commonly used for electrodes. If a cell is made of two electrodes of copper similarly coated with cuprous oxide and immersed in an electrolyte the potentials set up are equal and opposite, hence no current would flow in an external circuit were one connected. If, however, *one* of the electrodes is illuminated an additional electromotive force is produced, which may be measured, and current will flow in the external circuit, if one be connected. The general dynamic response of the ordinary photo voltaic cell is inferior to the selenium cell and is far inferior to the gas filled photo electric cell.

A New Departure in Spotlights

(*Continued from page* 14)

The entire arc mechanism may be raised or lowered for centering the crater with respect to the lens, and also may be tilted to obtain the correct burning angle, which depends on the horizontal tilt of the lamp. This angle once set for a lamp in a particular location, always remains the same. A metal shield, positioned in advance of the arc, eliminates the projection of the arc flame.

Marked scales and dials are provided for the assistance of the operator. One indicating the horizontal position of the hood, another the vertical position of the hood, and the third the position of the arc mechanism—thus allowing the operator to set his lamp for any degree spot and at exactly the desired position, without first shinning the light on the stage.

Five colorframes are provided, enclosed in a colorbox permanently mounted on the front of the spotlight and operated through an ingenous arrangement of levers which extend along the side of the hood. These are situated in the most practical location and the new operating mechanism eliminates the use of strings.

Each colorframe has its individual lever, marked to designate the color it controls. The position of the lever indicates the position of the colorframe, and a quarter turn throws the screen in or out of position. Standard 8″ colorframes are used, which are slipped into their holders, thus permitting quick and easy changing of colors.

Slide grooves are also provided on the front of the color box for an extra color frame, color wheels, special effects, and spotlight attachments.

An iris shutter is part of the permanent equipment operated by a handle at the back of the spotlight and by an auxiliary handle on the side near the front of the spotlight. Markings on the spotlight and the position of the handle indicate the relative opening of the shutter.

A curtain shutter is made part of the permanent equipment, and it too is operated by a handle at the rear of the spotlight. A quarter turn of the handle closes the shutter from full opening to black-out, or vice versa.

A fixed resistance for connection in series with the arc is furnished as a separate unit so that it may be mounted back of the switchboard or in some other out-of-the-way location.

The carbons recommended for use are ¾″ x 12″ cored projector carbons in the top holder, and ⅜″ x 6″ silver-tip carbons in the bottom holder.

The spotlight is furnished complete with color frames, asbestos leads, and an enclosed knife switch mounting on the base.

An automatic blackout shutter, operated from the stage switchboard can be quickly installed on each lamp, making an instantaneous blackout for all lamps when required.

The Rejuvenation and Preservation of Films[*]

By J. A. NORLING[**] and ALBERT P. RIPPENBEIN[†]

This paper briefly describes a method of treating positive and negative motion picture film for eliminating abrasions and scratches and improving its elasticity. There are two treatments: (a) the rejuvenation or regeneration process, by means of which worn and damaged negatives and positives are restored to good condition and (b) the impregnation-preservation process, by means of which new negatives and prints are given a longer life in service or in storage. The processes do not involve the use of lacquers or coatings, but depend upon the swelling and contraction of the film and the glazing of the surface in order to resist scratching and accumulation of surface dirt.

A PHOTOGRAPHIC film contains colloidal systems which tend to change as the film ages. This change develops serious symptoms: the film shrinks and tends to become dry and brittle. The mechanical strains and stresses to which dry and brittle films are subjected during use soon cause a breakdown of perforations.

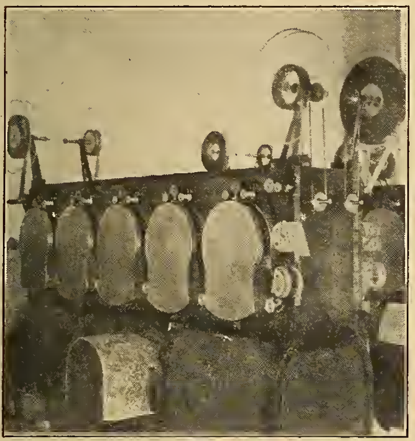


Fig. 1. Film Cleaning Machine

The nature of the photographic emulsion, and likewise, of the base, makes it a receptive medium for accumulating moisture, oil, and dirt. The substances of which the emulsion is composed are not highly resistant to abrasion and scratches appear in a short time under normal use. These scratches become receptacles for dirt. The dirtier a scratch, the worse it appears when projected.

Therefore, when a film becomes scratched during the first run, which may occur on poor equipment or on good equipment improperly operated, subsequent use of the film will make these original scratches more and more apparent. In addition, new scratches will be added constantly, and by the time the print arrives in the smaller theatres, it has acquired the "rainy" appearance which has been a source of much perturbation to conscientious projectionists throughout the country.

Any process that will reduce scratching, wearing, and absorption of dirt will be of great benefit to the industry. Many processes have been used which involve the use of lacquers and varnishes. The Recono processes differ from these in that they do not employ any lacquers or coatings whatever.

Two Distinct Treatments

These processes for treating film were developed by Frederick J. J. Stock, of Munich. They have been in successful use in Germany for the past eight years, and in this country since the beginning of 1930. They provide two distinct treatments: (*a*) the rejuvenation or regeneration process, by means of which worn and damaged negatives and positives are restored to good condition; and (*b*) the impregnation-preservation process, by means of which new negatives, black-and-white and color prints, and prints made by the different color processes, are given a longer life in service or in storage. The treatments are similar in the following respects:

(1) They are both essentially chemical treatments which effect definite physical and chemical change in the film.

(2) Both treatments involve an impregnation of chemicals into the emulsion layers and, in the case of the rejuvenation treatment, into the celluloid as well. The emulsion layers and celluloid are made to swell and are partly liquefied in order to permit them readily to absorb the chemicals required in the process.

The Rejuvenation Process

By the rejuvenation process, scratches and abrasion marks on both the emulsion and celluloid sides of negatives and positives are almost entirely removed. Dry, brittle film is restored to an elastic condition, and warped film is straightened. The removal of scratches is effected by causing a temporary swelling of the celluloid and emulsion layers, thus bringing together the walls of the scratches.

After the swelling is reduced by drying, the walls of the scratches adhere. Elasticity is restored by impregnating the celluloid with material to take the place of the material that has evaporated. Neither distortion of the film nor disturbance of the relative positions of the silver grains results from this treatment. The impregnation-preservation treatment is applied only to the emulsion side of negatives and positives with the following results:

(1) The surface of the emulsion is increased in hardness, making it more resistant to scratching. This advantage is obtained not only without the accompaniment of dryness and brittleness, but with an actual increase in the film's elasticity, amounting to as much as 15 per cent when measured at the breaking point.

(2) The emulsion surface is given a high gloss which has a beneficial effect in resisting scratches and accumulation of surface dirt. This gloss makes waxing unnecessary.

(3) The emulsion layers are made resistant to the absorption of oil and moisture, and the original moisture content of the emulsion is sealed in. The film therefore tends to retain the moisture necessary for preserving its elasticity and its tendency to resist buckling or warping under excessive heat.

(4) Perforation checking and damage are reduced because of the greater permanent elasticity imparted to the film.

Two Steps Required

The first step in the rejuvenation process is the cleaning of the film.

Condition	Thickness in Mm. (Average of 15 Tests)	Test No.	Per Cent of Elongation at			Tensile Strength (Breaking Weight in Kg. per Cm. Width)
			7.5 Kg./Cm.	10 Kg./Cm.	Breaking Point	
Not Treated	0.146 mm.	1	2.2	3.2	36	15.65
		2	1.8	3.0	33	14.30
		3	1.8	3.0	28	13.95
		Average	1.9	3.1	32	14.60
Treated	0.148 mm.	1	2.0	3.4	33	14.35
		2	1.8	3.2	37	15.15
		3	2.2	3.5	40	16.15
		Average	2.0	3.4	37	15.20

Comparisons of Elongation and Tensile Strength

---

[*] Courtesy of the S. M. P. E. Journal.
[**] Loucks & Norling Studios.
[†] American Recono, Inc.

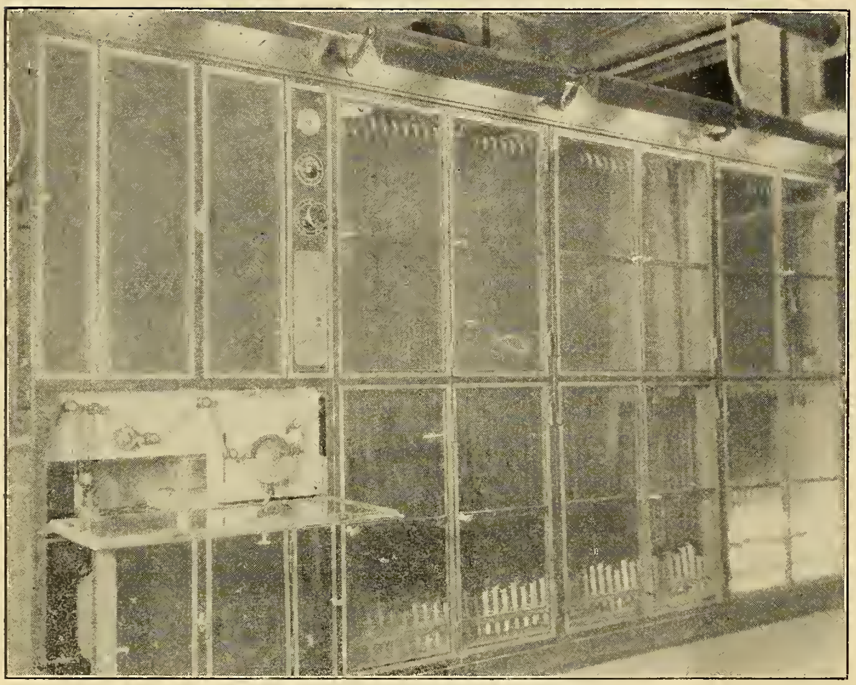


Fig. 2. Film Treating Machine

This cleaning is done on machines such as are shown in Fig. 1.

The film first passes through a cleaning solution such as trichlorethylene and is then brushed thoroughly, first on one side, then on the other. The brushes penetrate to the bottom of the scratches and remove dirt particles.

The second step is a chemical treatment based on the swelling of the celluloid substances, and the liquefaction of the surface to a certain degree which permits the substances to penetrate into the picture layers. The swelling of the material thus effected varies from 21 to 36 per cent, depending on the type and make of film.

The swelling, which at the beginning diminishes rapidly, only amounts to about half the quoted value after 48 hours; the loss of the liquid by evaporation then proceeds very slowly, so that even after a year a slight swelling may be in evidence.

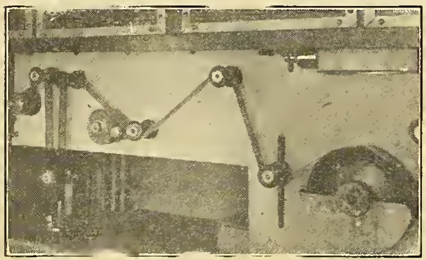


Fig. 3. The Applicator

The chemical treatment is given in the machine shown in Fig. 2. The close-up, (Fig. 3) show details of the applicator cabinet. The applicator wheel is shown at the right. It serves to carry to the film the correct quantity of solution, which can be regulated within close limits. Both negatives and positives are treated in machines of the same type, the solutions differing according to the nature of the film.

In the impregnation treatment for preserving new film, the emulsion layer is subjected to a similar colloidal process. By means of this process suitable substances are introduced which form, with the gelatine, colloidal complexes of increased resisting power which retard the tendency of new film to shrink and which harden and make glossy the emulsion surface so that it can better resist mechanical attacks. This treatment also increases the elasticity of the film, particularly at the perforations, resulting in longer life. There is a very slight increase in the thickness of the film amounting to less than 1/20 of one per cent (about 0.002 mm.), a negligible amount. There is, however, no coating over the emulsion.

The application machine is similar to the one shown in Fig. 2 and Fig. 3. Tests have indicated certain improvements when the film is impregnated. Elongation and tensile strength comparisons are shown in the table.

These tests were made by the Prussian Government Material Testing Bureau. Film strips 10 cm. long were used. The perforations along each edge were cut off, making each strip 2 cm. wide. Standard testing apparatus was used to obtain the data for elongation and tensile strength. As can be noticed, a distinct improvements in elastic quality is characteristic of the samples of impregnated film.

RCA Photophone Markets New Type Disc

WITH approximately 4.000 theatres employing the disc method of sound reproduction as a market, and having arranged with 90 percent of the producers of sound motion pictures for the recording of their output, RCA Photophone, Inc., has begun the distribution of a new type of disc record which has been developed and perfected by the engineers of the RCA Victor Company at its plant in Camden, New Jersey. This new disc which is called the Victrolac Record, is an improvement over the old style of shellac record in a number of respects, with advantages that at once become apparent to the producers and no doubt will be welcomed by all exhibitors who still retain the disc method of sound reproduction.

Among the important features which make this new record vastly superior to the old are the reduction in size from 16 inches to 12 inches in diameter, the pronounced reduction in weight from 24 ounces to 4 ounces, its flexibility and durability, improved tone quality and a minimum of surface noise.

An Important Development

"The new Victrolac Record which was recently developed by the RCA Victor Company and which is now being distributed by RCA Photophone, Inc., is one of the most important developments in the art of disc recording and reproduction that has been brought out in the past twenty years," said Mr. Lowell V. Calvert, manager of the Department of Recording Operations of the latter corporation. "It has so many advantages over the old type shellac record that the major producing corporations have accorded its introduction a most enthusiastic welcome. That it will be similarly received by the 5,000 or more exhibitors who retain disc equipment in their theatres, there is not the slightest doubt, especially in view of the fact that 90 percent of the producing corporations already have arranged with us to employ this record in transferring the sound tracks of their sound-on-film productions for disc reproduction. It will mean a considerable saving to them in the matter of express charges alone.

"Not much thicker than a sheet of heavy paper or light cardboard and being practically unbreakable, the new record does not require the delicate handling that was necessary with the old shellac record. In spite of the reduction in size of the record from 16 inches to 12 inches, the 1,000 feet of film recorded is still maintained. This has been accomplished by employing a lower amplitude of recording, smaller grooves and the placing of the grooves closer together. On the old shellac record, there were 90 lines per inch. On the new, from 120 to 130 lines may be recorded. Victor 100 per cent shadowgraph inspected or chromium tipped needles are required for satisfactory sound reproduction."

Principles of the Electric Arc

By ARTHUR W. SCHNEIDER

In the article which follows the author gives a brief outline of the history and the development of the electric arc and discusses the properties and the principles underlying the arc phenomenon. The article does not restrict itself to the arc as known today in motion picture projection, but is somewhat more general in scope. Certain facts are presented concerning the color effects produced by impregnating the arc carbons with various mineral salts. The information supplied should prove helpful to the projectionist and perhaps suggest to him avenues along which interesting and profitable research may be conducted.—THE EDITOR.

THE phenomenon of the electric arc was first demonstrated by Sir Humphrey Davy in 1800 when he exhibited to the Royal Institute an apparatus by means of which a continuous spark was produced in a gap between two pointed pieces of charcoal whether the electrodes were exposed to the open air or immersed in water or other liquid. Continuing his research Davy succeeded in the year 1808 in producing an arc nearly four inches in length. Power for this arc was obtained from a battery composed of 2,000 elements.

In 1843 carbon conductors, formed by the destructive distillation of coal, were used by Foucault. Later various substances were introduced into the carbon to increase the length of the arc and to steady it.

Requirements for Arc

The first essential required for the production of an electric arc is an electric current of sufficient tension to force its way across the gap or opening in which the arc is to be produced. Unless there is a very large difference in potential between these terminals, there must first be contact between the two carbons—that is, the arc must be "struck." The action produced in striking the arc is as follows:

When the two carbons are brought together an electric current flows in the circuit. As they are separated, a minute spark is produced and a part of the carbon is volatilized permitting the current to pass from one electrode to the other by using this volatilized matter as a conducting medium. The heat thus produced is so intense that it is necessary to employ electrodes composed of highly refractory material in order to prevent their melting and to avoid too rapid vaporization. It has been found that carbon is the substance which best meets these requirements.

An arc can be produced from either alternating or direct current. A pressure of approximately 45 volts is required to maintain an arc between carbons exposed to the open air. If the carbon are enclosed so as to prevent the escape of the carbon vapor, as in the case of certain modern lamps used for street illumination and other purposes, a pressure of about 75 volts is needed. The current varies with the size of the carbons and with the applied electromotive force.

When direct current is used the negative carbon assumes a pointed shape, but it is consumed only one half as rapidly as the positive carbon during the operation of the arc. A crater is formed in the positive carbon. Both carbons are incadescent at their tips and from this source considerable light is emitted. However, 85 percent of the light comes from the crater of the positive carbon. The arc itself contributes about 5 percent of the light and the remaining 10 percent comes from the tip of the negative carbon. Some commercial positive carbons are constructed with a hard shell and a soft core to facilitate the formation of a perfect crater.

The effect of alternating current upon the carbons is quite different from the action to be observed when direct current is applied. No crater is formed on either carbon. The alternating current arc is much less efficient than the direct current arc in that it is extinguished for every reversal of the current. This means that if an alternating current of 60 cycles is applied, the arc will go out 120 times per second or once for every reversal or alternation of the current.

Form and Color

There are many factors which influence the shape and the color of an electric arc. If it is placed in a magnetic field, the tendency will be for the arc to spread out in a disc shape. This effect is produced by the fact that the electrons present in the arc vapor are attracted to the poles of the magnet. The magnetic field of the earth also influences the shape which an electric arc assumes. It is for this reason that the arc takes on its peculiar bow shape when the electrodes are set up in a vertical position. Incidentally, it is from its bow shape that the arc derives its name.

The color of the arc is determined by the composition of its electrodes. In general, however, its light resembles sunlight, but is richer in violet rays. A color analysis of the electric arc shows that its central portion is of a violet hue. This is the vapor of the carbon, which is rendered incandescent at the crater. Surrounding this violet colored region is a non-luminous area where a dark flame indicates that the oxygen of the external air is being combined with the carbon, and carbon monoxide is being further oxidized forming carbon dioxide.

The so-called "flaming arc" is produced by impregnating the carbon electrodes with certain mineral salts. Its appearance is quite different from that of the common carbon arc. The arc flame itself is rendered intensely brilliant by the luminosity of its metallic vapors due to the great heat of the arc, and only a small portion of the light comes from the crater. Such arcs give from three to four times the illumination of the ordinary arc. The color of the arc depends upon the character of the salts used. It is usually, however, a dull orange color.

A luminous arc lamp used extensively today is so constructed that an arc is maintained between a copper electrode and a magnetite electrode. There are also other substances which can be used as electrodes between which an arc can be established. It is in this class that most vacuum arcs may be included, such as the Cooper-Hewitt mercury lamp.

Structure of Carbons

The ordinary carbon arc utilizes long cylindrical electrodes prepared from petroleum coke, gas coke, or lampblack. The raw materials are successively crushed, roasted, powdered, and bolted, then mixed with hot pitch. This compound is allowed to cool, and is then powdered, reheated and formed into molds or forced through dies into cylindrical forms, and is finally baked. The better grades of carbons are usually forced.

In some cases the cored carbon mentioned in the earlier section of this paper is produced by filling the axial hole in the carbon with a mixture of powdered carbon and salt. This mixture volatilizes more readily than the basic carbon and improves the steadiness of the arc. In addition to this, it brings about the formation of a better crater.

Various Types of Lamps

In the "flaming" arc, as has been previously observed, the carbons are strongly impregnated with mineral salts. Calcium salts are used when an orange light is desired and barium salts are employed to produce a white light.

Another type of arc lamp is the metallic oxide or magnetite arc. In this arc the positive electrode is made of copper, which remains inert and is not consumed to maintain the arc.

(*Continued on page* 41)

Some Aspects of Loudspeaker Development

By W. L. WOOLF†

The third installment of Mr. Woolf's treatise on the subject of loudspeaker development is devoted to the tone chamber and its influence on the quality of the reproduced sound. A number of different types of tone chambers are considered and some interesting conclusions are drawn concerning them. THE MOTION PICTURE PROJECTIONIST *is deeply indebted to Mr. Woolf for the masterly way in which he has presented his subject.*—THE EDITOR.

Part III

IN loud speakers of either the cone or horn type, a vibrator is actuated by a motor. The first article of this series dealt with motors and the second article with vibrators. This article deals with the construction of those parts of a loud speaker which affect the quality of sound after it leaves the diaphragm or vibrator and before it reaches the ear.

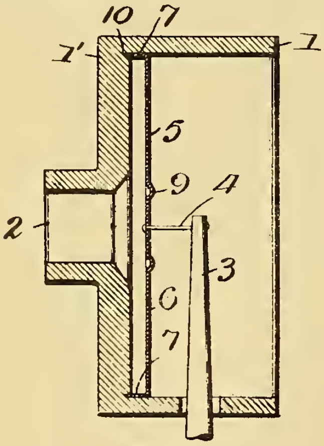


Fig. 1

It is entirely possible to select a motor capable of driving the diaphragm with satisfactorily uniform efficiency over the desired audible frequency range of say, from 85 to 8500 cycles per second and to employ this motor to drive a piston diaphragm of light weight and flexible periphery without receiving the desired results when interpreted as sound. It is necessary to employ such designs as will effect a satisfactory transfer of energy from the diaphragm to the surrounding air.

Cone speakers, due to the size of the cone, in the process of vibration, obtain sufficient grip on the surrounding air to cause the surrounding air to vibrate in unison with the vibration of the cone. This is due to the large size of the cone itself. The disadvantage of the cone speaker lies in the excessive weight of the vibrating parts which absorb a great deal of energy and in the fact that with an increase in the size of any vibrating part, it becomes increasingly difficult to maintain the vibration of that part as a whole, and to avoid vibrations within the material itself which set up undesirable sound frequencies.

Advantages of the Small Diaphragm

The diaphragm of three or less inches in diameter can be made both much lighter than a cone and comparatively more rigid. The light weight of the diaphragm permits it to vibrate as a whole at much higher frequencies than the cone and its rigidity permits it to create a purer wave form. Inasmuch, however, as the diaphragm is small in size, it does not grip enough of the surrounding air to permit it to become a satisfactory loud speaker when vibrating in free air. It is therefore necessary to contribute to the diaphragm some means of loading it, in order that the kinetic energy which it possesses by virtue of its rapid vibration, may be transferred into the surrounding air, causing it also to vibrate in unison with the diaphragm.

The most common and perhaps the oldest devices consisted of placing the diaphragm in an air tight tone chamber supplied with a horn. The oldest diaphragms were flat and the inner surface of the tone chamber was parallel to the diaphragm. Many investigators saw the necessity of an improved type of diaphragm without giving thought to the necessity of altering the tone chamber above the diaphragm in order to achieve the best results from the diaphragm and motor at hand.

Tone Chamber Construction

In Fig. 1, there is shown the usual diaphragm in a tone chamber which leads out of the unit and into the throat of the horn. The horn is not shown. Vibrations of the lever 3 are transmitted to the diaphragm through the reed 4. This simple type of tone chamber possessed a number of disadvantages which require correction before the best results from loud speakers could be obtained. The length of the wave path from the center of the diaphragm to the throat of the horn is much shorter than the length of the path from the periphery of the diaphragm to the throat. An impulse traveling from the center of the diaphragm therefore reaches the throat of the horn at 2, before the impulse from the periphery at 7.

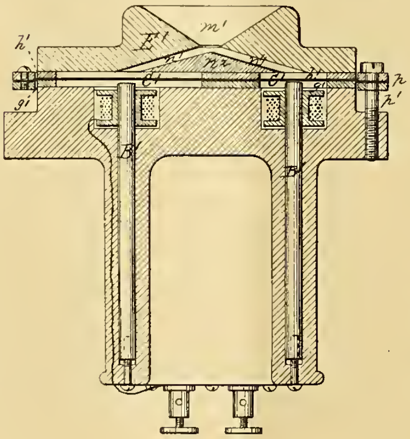


Fig. 2

Inasmuch as the wave length of the higher desired frequencies is approximately from one to two inches, a diaphragm with a one- or two-inch radius could produce a train of waves which would reach the throat with variations in wave phase through a complete cycle, that is, an impulse from the periphery may reach the position 2, at the same time that the next succeeding impulse from the center of the diaphragm reaches the position 2, thus building up the strength of that particular frequency which results in the arrival of an impulse from the periphery and the center of the diaphragm in the same phase at the same time.

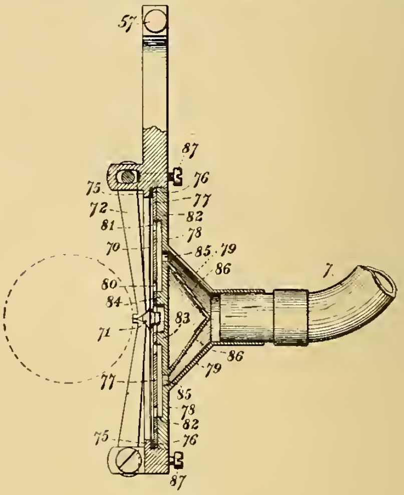


Fig. 3

A different wave length may be such that the arrival of the impulse from the center and the periphery would be exactly out of phase so that the impulse from one part of the diaphragm practically nullifies that from another part. In order to obviate this phenomenon, investigators have sought to balance out the lengths of the paths from the various elements of the diaphragm to the throat, in order that impulses from all parts of the diaphragm will arrive at the throat at the same instant and in the same phase.

Another disadvantage of the type of tone chamber shown in Fig. 1, is the fact that a pressure wave emanating from the diaphragm, strikes the upper surface of the tone chamber and is reflected back to the diaphragm. This period of reflection is definite in time and when the note is struck which corresponds in period to the natural period of the tone chamber, resonance occurs which builds the note of this particular frequency up to many times the volume of other notes, thus causing blasting and distortion.

---

†The Amplion Products Corp.

A third disadvantage of this type of tone chamber is due to the fact that the enlarged air cushion above the diaphragm absorbs higher frequencies, causing them to reach the throat of the horn with such diminished amplitude that they are inaudible.

A fourth disadvantage lies in the fact that due to the ready movement in the air of the tone chamber, the air does not resist the movement of the diaphragm or load it, the diaphragm energy thus being extended in its own motion rather than in being transmitted into motion of the air.

As previously stated, the purpose of this article is to examine the work of past investigators to ascertain the various methods adopted to solve this problem.

Tone Chamber Modifications

As early as 1878, Eickemeyer inserted a plug in his tone chamber slightly above the diaphragm, causing the air paths to travel out from the center of the diaphragm and in from the periphery to a common passageway formed between the plug and the inner shell of the tone chamber. Eickemeyer's construction is shown in Fig. 2.

In his studies of the phonograph, Tainter gave careful consideration to the form of air chamber above the diaphragm. By placing a plug within his tone chamber, he was able to increase the efficiency of his recording device on high frequencies, and to record higher frequencies than he was able to attain without this improvement. In a patent granted to him in 1887, Tainter states, "As heretofore made the recorder did not act as efficiently in recording sounds of high pitch as in recording sounds of lower pitch. This is believed to be due to the fact that when the sound waves impinge directly against the center of the diaphragm the latter does not act as a unit, for if the sounds are sufficiently high, two or more waves in opposite phase may, owing to the length between the center and circumference of the diaphragm, be acting upon it at the same time, and a differential effect is the result instead of the full force of the wave. This difficulty may be overcome by constructing the sound conveying passage to the diaphragm in such manner that the atmospheric vibrations will act simultaneously upon the whole surface of the diaphragm.

"The best embodiment of this principle would be to construct a large air chamber of conical form in front of the diaphragm, communicating at its apex with the mouth-piece; but this plan is not feasible, because the vibratory air-space in front of the diaphragm must be made very thin, or otherwise a disagreeable hollow quality is manifested in the reproduced sound. The object sought, however, may be practically attained without dispensing with the thin air-space, which is found to be advantageous, by dividing the sound-conveying passage as it approaches the diaphragm into a number of branches equal in length and communicating with different points on the surface of the diaphragm, whereby the latter is caused to vibrate with practical uniformity in every part, even with sound of high pitch." Tainter's device is shown in Fig. 3.

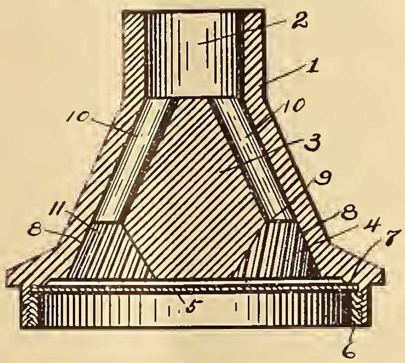


Fig. 4

The Hill "Air-Hammer"

In 1901, Hill while working on the phonograph employed a cylindrical plug in the throat of the tone chamber. This plug he termed an "air-hammer." Speaking of his device he says, "I find that by the employment of an air-hammer secured to the diaphragm as explained, the vibration of the diaphragm causes the air-hammer to vibrate within the passage, setting up air vibrations in the passage in exact accordance with the sound-record, resulting in very perfect reproductions and eliminating to a large extent extraneous and disagreeable sounds." In all probability, had Hill removed his plug or "air-hammer" from the diaphragm, spacing it at an appropriate distance therefrom, he would have obtained in addition to those benefits which he describes, a very greatly increased efficiency over that with which he appears to have been content.

Fritzsch in 1917, also employed a plug attached to a diaphragm. The Fritzsch plug being conical in shape is described by him as follows: "The conical boss (or plug) is secured centrally to the inner face of the diaphragm with the cone concentrically projecting into the throat so as to constrict but not close the passageway between the sound generating chamber and sound arm. Apparently this cone acts as a governor in this sound generating chamber to prevent over-vibration, the effect being to prevent blasting or sounds produced by improper diaphragm operations."

In 1907, Smith employed a somewhat similar conical plug and arranged a small baffle above the diaphragm to cause the lengths of travel from various parts of the diaphragm to the throat to be equal.

The Hunter Device

Figure 4, shows a Hunter device of 1907. Speaking of his invention Hunter said, "My invention relates to devices for taking and receiving the sound waves developed by a vibrating diaphragm, whether vibrated directly or by mechanical action, to collect the waves and deliver the vibrations into a tubular passageway, and the object of the invention is to provide a chamber for the reception of the wave vibrations, with a plurality of passageways therefrom into the conveying tube, whereby the vibrations may be collected, condensed, and delivered more perfectly than with the sound recorders heretofore in use.

"Heretofore it has been customary for talking machines and the like to provide a cup-shaped chamber in the rear of the diaphragm, which receives the sound vibrations, and to deliver these vibrations from the recorder through a single central passageway. I have ascertained by repeated experiments, however, that if an annular chamber is provided and the sound waves conveyed into the tubular passageway through a plurality of openings from this annular chamber, a very much smoother and better volume of sound is produced, or conveyed by the apparatus."

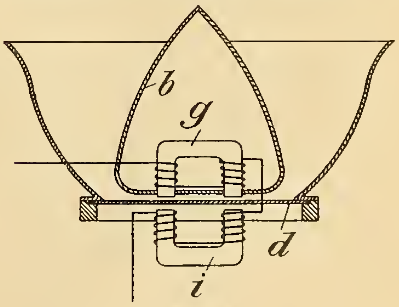


Fig. 5

Tigerstedt's Contributions

In 1918, Tigerstedt produced a number of loudspeakers, recording machines and microphones, in all of which he employed a tone chamber with a heart shaped core which spread the sound waves from the center of the diaphragm outwardly toward the periphery and thence into free air via a space formed by the inner surface of the tone chamber and the outer surface of the heart shaped plug. Tigerstedt's device is shown in Figure 5.

Tigerstedt discovered that by placing a surface adjacent to the diaphragm and compelling the sound waves to travel through a consequently restricted area, he was permitted to load the diaphragm, obtaining greater response from the air and consequently a greater amount of energy was transmitted into it. Also, the loading of the diaphragm contributed to its operation as a whole and prevented undesirable cross vibrations. Speaking of his device Tigerstedt says, "In devices of the type referred to it was common practice to provide, opposite the diaphragm, a guide for the sound waves, as, for instance, a mouth-piece or the like, having a central opening for the passage of the sound waves.

"Since the central opening in the guide was usually comparatively small, the mass of the diaphragm caused to vibrate by the sound waves was also comparatively small. Thus, with devices, as heretofore constructed, much difficulty has been experienced in transmitting sound waves to somewhat far distances, and no mechanism has, to my knowledge, heretofore been devised embodying any practicable means for enabling a clean transmission of sound waves to far distances so that they will be clearly comprehended at distance places.

"The object of the present invention is to obviate the aforesaid difficulties and to correct a vital imperfection. To this end I provide means whereby the sound waves will be conveyed from the rim of the diaphragm to its center and vice versa, thereby enabling the diaphragm to be acted upon by or to produce a greater quantity of sound waves."

Gruber's Work

In 1929, Gruber took advantage of this principle and invented a speaker, the driving mechanism of which was placed within the heart shaped plug near the surface of the plug consisting of a small cone. Gruber describes his device as follows:

"In connection with talking machines, loud speakers, broadcasting receivers and the like, it is common practice to use a diaphragm of small size, say from one and one-eighth inches to two inches in diameter, in connection with a horn having a maximum cross diameter much greater than that of the diaphragm. Of recent years there has been a tendency to substitute, for the horn and small diaphragm, a hornless apparatus, consisting as far as practicable of a diaphragm of relatively large size.

"This offers advantages of simplicity, compactness and lightness, together with possibilities of cheapness. In order to give adequate volume to the sound produced, however, it is necessary to employ some expedient to cause the entire diaphragm, or a large portion of it, to move as a unit in the production of sound waves. As a rule, it is desirable to make either the diaphragm stiff, or to maintain it under tension, or to brace it at a plurality of points in order to insure that the diaphragm, when actuated, will as far as practicable execute piston-like movements against the air.

Certain Difficulties

"A conical diaphragm, either stiff or under tension is appropriate for the purpose just mentioned, but here arises a difficulty. If the conical diaphragm be too small, it does not make contact with a sufficiently large area of the adjacent air, and if too large, it does not readily execute the required piston-like vibratory movements, and especially for the finer overtones. It is indeed a difficult matter so to proportion a particular diaphragm as to give it an area large enough for adequate volume, and yet small enough for fidelity in the reproduction of the higher overtones, and of complex and delicate sounds. The usual expedient is a compromise, namely, the use of a conical diaphragm not less than nine inches and not more than fifteen inches in diameter.

"I have made the discovery that by the use of a relatively small diaphragm of suitable form, say a conical diaphragm four, five or six inches in diameter and operated under tension or not as conditions may require, coupled with a reflecting sound chamber of special form and used as hereinafter described, I can give proper expression to a wide range of overtones, and produce sounds of great delicacy and complexity, and yet can produce adequate volume such as is not ordinarily produced except by a diaphragm of much larger size or by the addition of a horn."

Graff also used a flat diaphragm attached to a unit located within the plug and used an adjustable surface adjacent to the bottom of the plug by means of which he adjusted the distance between the diaphragm and the case to create a resonance period suitable to the ear of the operator.

Hensley studied refinements of air chambers from 1915 to 1923 and employed plugs of various shapes, sizes, materials and consistency.

The Amplion Octophase

A recent unit of interest is the Amplion Octophase. This unit employs the movable coil motor contributed by Sir Oliver Lodge, the principle of the piston diaphragm taught by Edison, Stroh, Coombs, and others and takes advantage of the principles of tone chamber construction taught by Eickemeyer, Tainter and Tigerstedt. In addition, refinements have been added whereby the area over the dome shaped diaphragm is divided into eight divisions. The centers of gravity of each of these divisions are exactly equi-distant from the throat of the unit. Channels are provided within the tone chamber to gather the sound impulses from each division and reach the throat of the horn in perfectly timed synchronism with the arrival of sound impulses from all the other divisions.

The application of the design principles above enumerated, permit the construction of a unit capable of reproduction of sound frequencies over a wide range with comparatively uniform efficiency.

The use of horns of heavy wall material with highly polished interiors correctly designed, results in a highly directional speaker. In such a device, the sound energy provided by the power amplifier is directed in a beam effect to the areas desired, not only avoiding the waste of energy, but sound waves are prevented from striking reflecting surfaces, such as ceilings and side walls, thus eliminating objectionable echoes and greatly reducing the period of audibility of a sound of any given intensity. This directional or beam effect also causes the sound to reach the listener from the direction of the speaker rather than from the various reflecting side surfaces, thus avoiding distraction of attention and creating a pleasing illusion, particularly in motion picture work.

Kliegl Issues New Catalog

Kliegl Brothers of New York, manufacturers of lighting specialties, have announced the publication of a completely revised new catalogue, with list prices adjusted to present-day levels, and with the very latest improvements and new devices for theatrical, decorative, and spectacular lighting, such as footlights, borderlights, spotlights, floodlights, and numerous other forms of lighting equipment and apparatus included in its pages. The publication is complete in every respect, fully illustrated, thoroughly indexed, and conveniently arranged for quick reference.

The new Kliegl Catalog A is available to anyone interested in lighting. Copies may be obtained, free of charge, by a request addressed to Kliegl Bros., 321 West 50th street, New York, N. Y.

Kaplan Society Holds Dinner Dance

The annual dinner dance of the Kaplan Projection Society, the educational and scientific division of Local 306, Moving Picture Machine Operators Union was held in the Grand Ballroom of the Hotel Commodore on Saturday night, October 31st.

A gigantic entertainment was provided which was staged under the direction of Larry Kent, chief of the short subject division of the Paramount-Publix Long Island City Studio, and Arnold Van Leer of the R. K. O. organization.

The S. M. P. E. Fall Meeting

OBSERVING at the same time its 31st convention and the fifteenth anniversary of its establishment, the Society of Motion Picture Engineers completed on October eighth last a four day symposium dedicated to the advancement of motion picture science. The meeting, which was held at the New Ocean House, Swampscott, Mass., numbered some one hundred and fifty members, and was marked by spirit of mutual helpfulness and a desire to be of genuine service to the industry at large. New officers were elected for the coming year, and at a banquet held in the evening of October 7th in the main dining hall of the hotel, high praise was bestowed upon the pioneers of the industry.

In an effort to complete the reading of the papers within scheduled time, practically every moment of the four days devoted to the meeting were given to the business of the society. Notable among the papers read at the convention were: "Motion Picture in Relief" delivered by Dr. Herbert E. Ives of the Bell Telephone Laboratories, "Development of the Light Valve" by T. E. Shea of the same company, "Notes on Vitrolac Motion Picture Records" by F. C. Barton, RCA Victor Company, and the reports, discussion and recommendations of the various committees of the society.

At the banquet on the evening of October 7th, tribute was paid to Thomas A. Edison, Frederick Ives, Louis Lumiere, Charles Francis Jenkins, George Eastman, Jean Acme Leroy and Eugene A. Lauste as torchbearers of motion picture science.

New Officers Elected

Officials elected to guide the destinies of the society through the coming year are: President, Alfred E. Goldsmith, vice-president and general engineer of the Radio Corporation. Vice-President, E. I. Sponable. Secretary, J. H. Kurlander, commercial engineer of the Westinghouse Electrical and Manufacturing Company. Treasurer, H. T. Cowlic, Eastman Kodak Company. The Board of Governors was attained by L. C. Porter, illumination engineer, General Electric Company, and O. M. Glunt, research engineer, Bell Laboratories.

J. I. Crabtree, Past President of the S. M. P. E.

The addresses of the retiring president, Mr. E. I. Crabtree, and of the newly-elected president, Dr. Goldsmith, which were delivered in the course of the society banquet, stressing as they do the present accomplishments and the future outlook of motion picture science, are reported verbatim for the benefit of our readers.

Mr. Crabtree's Address

"On a similar occasion as this two years ago, in response to a question as to how it felt to be a president-elect, I said that it seemed as though I had ridden down to the bottom of the Grand Canyon and I suddenly found that I had to walk back again. The journey, however, has been a very pleasant one and not as difficult as I had imagined, thanks to the loyal help of the members of the Board of Governors, the various committees, and the members at large.

"But there is hard work ahead for our Society. The present problem of the industry is not that there is any immediate need for new tools but that the industry should better know how to use the tools which it now has at its disposal.

"One of the most striking facts which a visitor from the east to Hollywood observes is that the quality of sound reproduction in the screening rooms of the studios is better than that which exists in the majority of theatres throughout the country. The inferences from this are two-fold, namely that the present size of the sound track is adequate for the industry's immediate needs and that sound reproduction in the theatres has not kept pace with recording in the studios. This is due to several causes including deficiencies in the maintenance of equipment, imperfect release prints, and imperfect projection.

Recommends Attention to Details

"Although a wider sound track, and especially sound tracks on a separate film, will give some improvement in sound quality, their general adoption will be impracticable for some considerable time to come. It, therefore, behooves the industry to pay the greatest attention to details so as to get the utmost from the sound track which is at present available. It is possible to get better sound by means of higher quality reproducing equipment such as the recording machines available for studio work but much improvement could be obtained by meticulous attention to details with present equipment.

"Demonstrations using hill and dale cellulose acetate disc records and improved reproducing equipment in-

Newly elected officers of the S. M. P. E. Reading from left to right: Dr. A. N. Goldsmith, president; E. I. Sponable, vice-president; H. T. Cowling, treasurer, and J. H. Kurlander, secretary cluding duplicate horns have revealed that it is now possible to reproduce music which goes one octave higher than is possible with present theatre equipment, and this addition imparts to the reproduction a striking degree of naturalness.

"Although I do not predict an immediate return to disc recording by producers, this epoch making advance in sound reproducing will, undoubtedly, serve as a stimulus to improvement in the reproduction of sound photographically.

Projectionists' Meetings Advocated

"In many cases imperfect maintenance and operation may be attributed to the fact that the projectionist is not always kept on his toes by virtue of his isolation. Even the most aggressive surgeons and professional men attend clinics at least once a year in order to keep in touch with the latest developments. It is the duty of the projectionist organizations to establish corresponding seminars in key cities, which projectionists from all theatres should be compelled to attend, substitutes being supplied to their own theatres during their absence. Also, more projectionists should be permitted to attend our conventions. The resulting stimulus and acquaintance with men who are constantly striving to improve the motion picture could not help but result in a marked improvement of the picture and sound quality in the theatre.

"There is also much room for improvement in theatre showmanship. The motion picture theatre of today is too much of a machine—it lacks soul and personality. More atmosphere and glamour could be created by individuality in the technical presentation of the picture. Neither sound nor picture are perfect replicas of nature but after four years of evolution the sound, as reproduced at present in conjunction with motion pictures, is more true to nature than the picture which lacks color and depth. The reproduction of speech is quite satisfactory but the reproducible volume and frequency range is inadequate to simulate orchestral music. The patron, however, does not realize these shortcomings if he is placed in the mood of willingness to believe by means of suitable atmosphere.

The Release Print Problem

"The problem of the quality of the release print is also a very urgent one. The difficulty involved is to produce release prints which are replicas of the best print which the original picture and sound negatives are capable of giving. To an impartial observer it would appear that the quality of the sound in the case of release prints, in many cases, is not equal to that of the first print produced in Hollywood. A second striking observation to the Hollywood visitor is the recent great improvement in laboratory equipment and the meticulous care with which the equipment is constructed and maintained.

"But the quality of the product largely reflects the quality of the manpower which produces it. In Hollywood there is a spirit of cooperation and friendly rivalry to produce the best motion pictures possible. It is highly important that the eastern technicians cooperate to the utmost not only with themselves but with the technicians in Hollywood, otherwise I predict that Hollywood will not only be the center of production but of laboratory processing as well.

Possibilities of Color Pictures

"But what will be the next outstanding technical development of the industry? Color is the only immediately available variant from the prevailing black and white picture. It has little box office value at present because the public thinks of colored pictures in terms of some of the wretched ones which it has already seen. You have seen some excellent examples of color motion pictures during our convention which were adequately sharply defined and when similar films are generally available, the public will undoubtedly register its appreciation.

"The next innovation will probably consist of the imparting of depth both to picture and sound. Demonstrations at our convention have indicated that the possibility of securing stereoscopic motion pictures without the use of auxiliary devices is not as remote as we had previously supposed, while in the case of many of the scenes of the color pictures referred to above, the color imparted a surprising degree of semblance of depth to the picture.

"It would also be possible to secure startlingly entertaining and amusing effects by the use of devices which would permit of binaural reproduction, whereby an independent sound record is transmitted to each ear. This would necessitate the use of multiple sound tracks on the film and independent reproducing channels leading to ear phones which the audience would undoubtedly tolerate for short presentations. The effect of a person whispering in the ear can be simulated with startling fidelity and such effects, judiciously combined with suitable picture material, would provide some of the necessary novelty to the motion picture presentation which the public is always anticipating.

The Outdoor Theatre

"Another development of the future during the summer months will undoubtedly be the outdoor theatre. The public is outdoor-minded and open air symphonies, outdoor plays, and outdoor events of every description have never been better attended. Rear screen projection has been developed to a point where adequate screen brightness is easily attained while the engineer could undoubtedly provide effective means to destroy intruding flies and insects.

"It is questionable whether the 16 mm. film in the home will ever be a serious competitor of the motion picture theatre as a means of entertainment. In the home, man is too inherently lazy to set up and operate a projection machine to exhibit pictures other than those of his own making in which his guests are usually not interested.

"The spectre of depression has been relatively kind to the motion picture industry. Present box office receipts are only 10 per cent below those of last year but the quality of the motion picture was never better than it is today. In order for business to improve, we must give better and better values. If the public knows anything at all, it knows values in entertainment. It was Emerson who said—'Let a man preach a better sermon, write a better book, or build a better mouse trap than his neighbor—though he build his house in the woods, the world will make a path to his door,' and his words are equally applicable to motion pictures.

"Better business is a question of each one doing more and better work than ever before—more intensive research work—the making of better tools—doing better work with existing tools—better stories—better direction—better acting—better film stocks—better camera work—better laboratory work—and better projection. So long as we continue to provide better entertainments, the continued success of this motion picture business is assured."

Dr. Goldsmith's Address

"The great honor which the Society of Motion Picture Engineers has conferred upon me, in granting me the opportunity to aid in its further upbuilding, is one which is at once most encouraging and a challenge to put forth my best effort on behalf of the membership. If I may speak for the officers of the Society for the coming year, it would be to express our appreciation of so fine an opportunity and our thorough understanding that whatever may be accomplished during the year will of necessity rest upon the firm foundation of splendid achievement of those who have in the past so capably conducted the affairs of the Society. If their wise guidance and advice will still remain at the disposal of the Board of Governors and the officers of the Society—as we are convinced it will—there can be little doubt that the Society will continue its healthy and constructive career.

(*Continued on page* 39)

Outline of Sound Recording

By GEORGE DOBSON†

Part III of Mr. Dobson's Outline of Sound Recording deals principally with the subject of recording on disc. The author describes in detail the manner in which such recordings are made and discusses the advantages and disadvantages of the disc as a recording medium.—THE EDITOR.

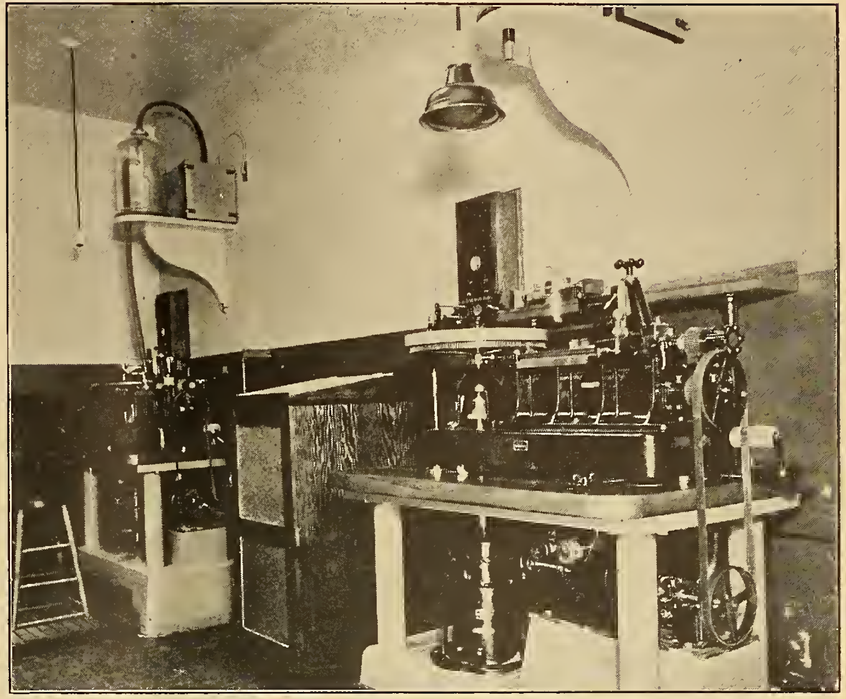


Fig. 8. Disc Recording Machines

Part III

IT will be noted from Figure 5 (see previous installment) that in the studio provision is made for two types of recording, disc and film. The first talking pictures, those made by Edison, which, however, were not a commercial success, used a phonograph record at that time in cylindrical form. The first talking motion picture which recorded sound and musical accompaniment, "Don Juan," with its accompanying shorts, as well as the overwhelmingly successful "Jazz Singer," both made by Warner Brothers, were on discs.

Commercial considerations such as ease of cutting the negative, facility in meeting the demands of the censorship boards by changes in the positive and somewhat simpler handling which, of course, is familiar to the projectionist, have placed sound reproduction by film commercially ahead of that on disc. One cannot foresee what may happen, but at present only 20 per cent of the reproduction is by means of the disc. In recording, however, the disc has the outstanding advantage that the sound can be played back immediately, whereas in film recording it is necessary to develop the negative and make a positive print before the sound can be reproduced.

When a director is in doubt whether the recording is satisfactory, or when artists new to the motion picture work are being trained, such an immediate reproduction is of great importance since it enables the immediate correction of faults of diction and verbiage, thereby saving much delay and many retakes. The relative quality of the two methods is still a moot point.

Disc Recording

However, in view of its historical importance and the fact that disc is still being used in a large number of theatres, a discussion of this method of recording may be of interest. It might be noted that while in only a few cases original recording is still being done on disc practically all the producers make their disc records by re-recording from original film records.

The method of recording on disc is at present very similar to the method of recording phonograph discs previous to the introduction of talking motion pictures. However, the stylus or cutting instrument, is electrically driven and an electric drive is also used for rotating the disc under the stylus.

To provide a material which can be readily cut, a so-called "wax" disc is used. This is actually a hard soap, somewhat similar to laundry soap in appearance, also containing other materials, such as Canuba Wax to make it easier to cut.

The Recording Turntable

This disc is rotated at a speed that must be so nearly constant, that it is only by use of special checking methods, such as a stroboscopic flashing light, or flutter tests, that even objectionable diversion from constancy can be detected. While the disc is rotating, the recorder is moved very slowly in a horizontal plane by means of a fine screw and a half nut so that if no talking currents are used to operate the stylus, a very fine spiral will be cut in the disc; the adjacent turns of the spiral being approximately .010" apart. The machine for accomplishing this is shown on Figure 8.

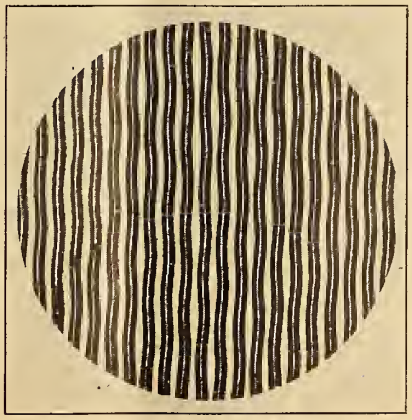


Fig. 9. Record, Magnified

The motor drive is under the bench at the right, and the large pot at the left contains the device for damping out any variations in the speed of rotation of the disc. The wax disc is on the left of the machine on the turntable. The edge of the latter is marked with vertical lines for checking the constancy of speed by stroboscopic methods. The microscope over the disc is for checking the width and cleanness of cut also for checking in case of possible overcuts. The small tube with the bent end in front of the recorder is normally connected by means of a rubber tube to the suction equipment above. It is used for removing the wax thread (cut by the stylus) so that particles of wax may not fall on the engraved portion of the wax and mar it.

Action of Stylus

When the talking currents are impressed upon the recorder, the stylus moves to and fro in a sideways direction, so that the spiral is no longer even, but takes a snake form. A small portion of the record, much magnified, is shown in Figure 9. The effect of a sound of constant pitch, when impressed upon the recorder, is to produce a regular wavy pattern.

---

†Commercial Engineering Dept., Electrical Research Products, Inc.

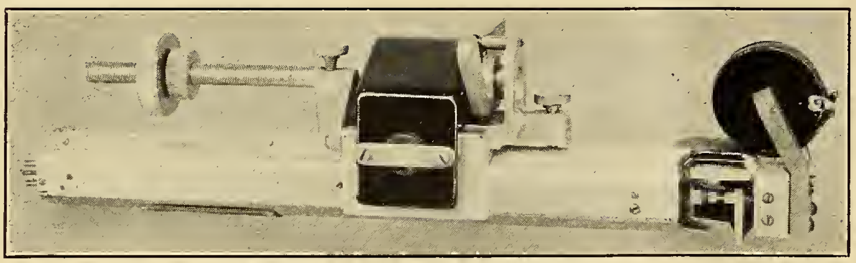


Fig. 10. Disc Recorder Head

The size of the groove is determined by the size of the reproducing needle which at present is the same as that evolved for phonograph disc. The depth of the groove is just sufficient so that the needle will stay in it when being moved violently from side to side by the waves in the cut. Since these side to side motions, although very small, may be as rapid as 6,000 times per second, it is obvious that there must be a very close engagement between the needle and the cut.

This is obtained by the use of somewhat abrasive materials in the final disc, which grinds the needle to the shape of the cut actually used. These abrasive materials are one of the causes of the hissing noise so frequently heard when discs are used and the elimination of the abrasive material and the use of other materials for the discs is one of the problems which is being extensively studied by many inventors. It appears probable that a solution of this will be reached in the near future.

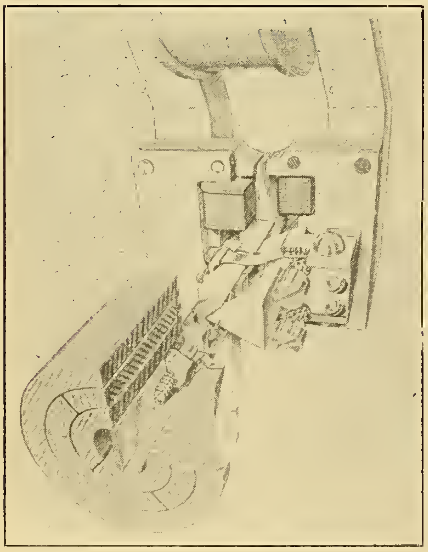


Fig. 11. Details of Recorder Head

From the above it is obvious that while the carefully designed drive is essential in recording, the recorder itself is the most important single element in this work. A picture of the recorder is shown in Figure 10 and an enlarged sketch of the moving parts in Figure 11. From the latter it will be seen that the recorder consists of the following parts:

An electro-magnet which is magnetized by means of the coil at the top. In the field of this electromagnet lies a diamond shaped armature. Around each pole of this armature is a small coil through which the sound currents pass thus causing a corresponding motion of the armature in the magnetic field. Attached to the armature is the stylus arm. This stylus arm has cut in it a V shaped slot at the bottom of which are two hard plugs which rest on two knife edges.

The stylus arm is kept pressed against these knife edges by means of a "U" shaped spring whose tension is controlled by two knurled screws, one above and one below the stylus arm. At the other end of the stylus arm of the armature is the rubber lining which absorbs most of the energy applied to the arm. At the bottom side of the arm projects the stylus holder which has drilled in it a small hole for holding the stylus. The latter is a small cylindrical sapphire which is ground to the proper shape to cut the groove in the wax. Referring to the Figure 11 it will be noted that at one side of the stylus there is another small projection which has at the end of it another small sapphire.

This sapphire is spherical at the end and is so arranged that it supports that part of the weight of the recorder which presses on the wax. It is known as the advance ball. By proper adjusting of the difference in height between the end of this ball and then of the stylus the depth and therefore the normal width of the cut in the wax is controlled.

Suction Equipment

In addition to the recording machine itself with the various accessory parts mounted upon it, the disc recording equipment comprises a suction equipment, a control box and the motor switches. The suction equipment may be individual for each recording machine as shown in the photograph or a common suction equipment with separate outlets at each machine may be used.

The control box contains a switch lamp for showing when the system is in operation, an attenuator for adjusting the sound currents to the proper value relative to the other machines and a meter and resistance for measuring and adjusting the field current of the electro-magnet of the recorder. The operation of recording and the use of these various parts will be discussed later.

(*To be continued.*)

Another Letter on the Standard Release Print

Editor, Motion Picture Projectionist:

I am watching interestedly the comments for and against the Standard Release Print and now feel urged to give my opinion.

The Standard Release Print is, I believe, a great step toward perfect presentation, but as yet it has not quite struck the mark under all conditions. The twelve foot numbered start has eliminated any excuse in exchange inspection for having the start mark and the picture out of frame. An evil of utmost degree until lately for the subsequent run houses.

Now we must take into consideration the dots. So many projectionists have rebeled against them. Do they ever go to see the show? If they did their interest in watching the picture will cause them to miss the dots. An audience will stand for a good deal of scratches, blotches, and dirt on the film before its attention becomes drawn from the picture to the mutilated film. Then it must be considered that the audience does not know what they are for and is not watching for them. Rebeling operators, ask your audiences about those dots and have them reply, "What dots?"

Next comes consideration of the distance between the dots. Therein lies its weakness. Twelve feet is insufficient. Why? The dots and the distance between the start mark correspond, but that does not give the projectionist time to make up for the machine's pickup. Western Electric equipment with a slow pickup and other machines with quick pickup, neither can beat the dots, consequently those projectionists having sound on film forget the advantage formed for them and start right on the pictures, and with the last set of dots, while disc projectionists must run the film down part way increasing the already numerous hazards of synchronism, or some of the still existing film butchers mark a line somewhat ahead of the first set of dots.

Why not increase the distance between the dots four and a half feet and give the machine a chance to get up to speed on the twelve foot leader? Then projectionists would start on the beginning. If this were done surely everyone would use it as insurance against faulty changeovers, and then who would need to rehearse his show? With such a step toward success already made, is there any reason for not stepping a little further and attaining success?

Clem Williams, Projectionist,
Olympic Theatre, Verona, Pa.

Report of the S. M. P. E. Progress Committee

THE following is an abridgment of the report presented before the Society at Swampscott, Mass., October 5, 1931. The entire report will be published in the December issue of the Society Journal. The complete personnel of the committee is as follows: G. E. Matthews, Chairman, M. Abribat, L. N. Busch, W. Clark, A. A. Cook, C. Dreher, R. E. Farnham, H. B. Franklin, J. G. Frayne, E. R. Geib, A. C. Hardy, F. S. Irby, R. C. Hubbard, M. W. Palmer, G. F. Racket, M. Ruot, P. von Schrott, H. Sintzenich, and S. K. Wolf.

Films and Emulsions—Interest in the adoption of wide film, though dormant for the past six months, is expected to be aroused again with the return of normal economic conditions. The high speed panchromatic emulsions introduced earlier in the year have been given exhaustive trial under the severe working conditions prevailing in the studios, both in this country and abroad. General satisfaction has been expressed by the trade on their characteristics. Huse has described a panchromatic film which has the emulsion coated on a support having a neutral gray density of 0.2 which is claimed to minimize trouble from halation.

During the first week of August, the Eighth International Congress met in Dresden, Germany. At this important gathering over 100 papers were read by scientists from many countries.

Studio and Location.—During the last six months, motion picture studios continued to make their sound recording equipment more portable and to bring the talking picture gradually to the same technical perfection as the old silent picture.

Until recently, it has been common practice in Japan to show two and sometimes three feature pictures and shows lasted sometimes as long as six hours. In order to supply the demand created by such exhibition schedules, a great many feature pictures were required. Last year 650 features were produced and this year almost as many were planned.

Cameras and Accessories.—Evident need for a greater standardization exists, particularly with regard to camera silencing. The Radio Corporation of America have announced the perfection of a silent 48 cycle camera motor which eliminates the necessity of gears between the motor and camera. They also announced a 720 r.p.m. silent camera motor for use on Fearless and Bell & Howell cameras.

Safety devices have been introduced which prevent damage to the mechanism of the Debrie camera in the event that the camera jams. A sound absorbing case covers the entire camera. For studio use, a special metal stand is provided which rides on three rubber tired wheels. The cameraman stands on a small rear platform.

Huguenard and Magnan have designed a camera employing four lenses and taking 12 pictures in an area the size of our standard 35 mm. frame. With a linear velocity of the film equal to 3 meters per second, 2400 pictures may be exposed per second. Pictures made of the free flight of a large fly show that it beats its wings about 100 times per second, whereas a Senegalese linit moves its wings only 30 times in a second.

Proposes Survey on Causes of Film Mutilation

Speaking as a member of the Projection Practice Committee at the recent convention of the Society of Motion Picture Engineers, Mr. P. A. McGuire of the International Projector Corporation directed attention to the tremendous losses incurred by the industry year after year through film mutilation.

Characterizing the evil as one of the most serious now confronting the field, the speaker stated that in his opinion conditions had reached such proportions as to justify a nationwide survey on the part of the Society as a means for the determination of contributing causes, and predicated on the findings, the institution of vigorous measures to remedy such abuses as may be found to exist.

An investigation such as that proposed, Mr. McGuire continued, would unquestionably prove of inestimable value, particularly, should it receive the whole-hearted support of all branches of the industry.

In behalf of THE MOTION PICTURE PROJECTIONIST, it may be said that its staff is entirely in accord Mr. McGuire's proposal. The evil is one of long standing. It is high time for the subject to be given the serious consideration which it demands. The line of least resistance has been to censure the projectionist. Undoubtedly, careless handling on the part of some projectionists is a contributing factor, but an intelligent and impartial investigation of the situation is certain to bring to light many unsuspected and interesting facts concerning the matter.

Studio Illumination—Very few new pieces of illumination equipment were introduced in American studios. An addition to the cast silicon-aluminum equipment announced in the previous report is a new spotlight employing a 2000-watt, 115-volt monoplane filament lamp.

For general lighting in British studios, banks of lamps are commonly used with as many as 40 lamps in a unit consuming about 10 kw. Matted aluminum reflectors are used for each lamp.

Sound Recording.—Maxfield has shown that an empirical relationship exists between the placement of camera and microphone, and the acoustic properties of the set. Some eight or ten pictures have been made using the technic, and the results were so well liked that a more general application of the principles is being made.

For the first time in the making of a sound motion picture, short wave radio communication was maintained between a ship at sea and the studio lot in Hollywood in the recent filming of the "Corsair," a United Artists picture.

With a new intensity meter, it is possible to measure sound and noise intensities in sound stages and theatres. Levels from 15 to 100 decibels above the hearing threshold may be measured. The instrument is characterized by its compactness and lightness of weight.

A permanent magnet light valve has been devised recently by Western Electric, in which the bulky electromagnetic field coil used in the previous type has been replaced by permanent pole pieces. The ribbons are clamped permanently in position after the initial spacing and tuning operation. The valve is very compact when used in a studio film recorder.

Satisfactory recording of frequencies up to 10.000 per second is claimed for the Fidelytone system of sound recording developed in England. An image of the cathode consisting of a long metal strip in an exhausted glass tube is formed on the moving film, the light glow extending along the length of the cathode from the metal anode opposite its center point. The length of the glow varies in accordance with the modulated input of the tube.

According to a report from Hollywood, a new dynamic microphone has been introduced which has an essentially flat response from 50 to 10,000 c.p.s. The Metro-Goldwyn-Mayer studio have accomplished an innovation by placing the microphone and associated amplifier in a spherical metal housing. Re-recording has assumed a new significance in connection with the dubbing in of foreign language versions with original American action pictures.

One item on the annual technical report of the A. E. G. for 1930 was a description of a new German re-recording apparatus. Three films may be passed through the device simultaneously and the record made on a fourth film, or on a disk.

Laboratory Equipment and Practic.—One of the most recent additions to the list of modern laboratories is the new M-G-M Laboratory in Hollywood. All film is processed on machines, of which there are twelve, and only that actually being handled is exposed as all other film is stored in self-closing steel lockers. The maximum capacity of the laboratory is 300,000 feet of negative and 4 million feet of positive per week. Each developing machine is a distinctly separate unit from the mixing tank and chemical room at one end to the dryer at the other.

For the convenience of motion picture companies, the Technical Bureau of the Japanese Railways are fitting up three cars so that film may be developed and printed enroute. Projection facilities are included.

Laboratory processing of negatives and master prints is quite satisfactory but evidence exists that much of this quality is lost in the preparation of release prints, on which the public judges the value of the entertainment of a picture. Recommendations are being drawn up to correct this serious production defect.

Depue of Chicago has announced a 35 mm. combination sound and picture printer, as well as a printer for color picture work. Duplex Motion Picture Industries, of New York, also have introduced a combined picture and sound printer as well as equipment for handling bi-pack negatives.

Standard Kine Laboratories in England have installed apparatus for working the Hepworth "stretched" negative process. Films taken at 16 pictures per second can be "lengthened" and subsequently projected at higher speeds. It is claimed that "slow motion" films can be made by this method from normal negatives.

A new model Bell & Howell splicer for 35 mm. film is equipped with disappearing pilot pins, for splicing 16 mm. film. A heating unit maintains a constant temperature in all parts of the machine with which the film comes in contact.

Projection Equipment and Practice.—Unperforated Czaphane film was projected on a Cinelux projector at a meeting of the French Société de Photographie held this summer. Although the facilities did not permit reproduction of the recorded sound, it was reported that the demonstration otherwise, was successful. Framing of the unperforated film was accomplished by projecting light through images of perforations (printed along one side) onto a selenium cell connected to a one tube amplifier. Splicing is accomplished by treating the surface with a normal zinc chloride solution at a temperature of 140° F.

Before films may be projected in Japan, the exhibitor must supply the police with a complete synopsis, including the exact words used in every title, or if a sound picture, the exact words spoken by every actor. Effective, April 21, 1931, the projector speed cannot exceed 28 meters per minute for sound pictures, or 24 meters per minute for silent pictures.

Sound Picture Projection.—While there has been some improvement in the quality of reproduced sound in the better type of theatre, during the past year there has been no radical improvement in the devices or in the method of reproduction. Very slight improvement, if any, has been noted in the quality of reproduced sound in smaller theatres.

The first Japanese sound pictures were produced during the past six months by two different companies. Disc recording was used. There are now 60 theatres, equipped for sound in Japan. Extensive introduction of sound picures is hampered, however, by the attitude of the Benshi, or professional announcers who are a regular member of the staff of every theatre. The general practice has been to reduce the volume of the sound sufficiently so that the Benshi can be heard with the result that very often the sound is cut out almost entirely.

A lamp for slitless sound reproduction has been devised by Dunoyer. Essentially the lamp consists of a cylindrical glass bulb having a flat piece of optical glass sealed in one end exactly parallel with a tungsten filament 25 mm. long and 0.1 mm. diameter. The filament is made in such a way as to be perfectly rectilinear at its normal temperature of 2290°K. The image of the filament falls on a triplet anastigmat lens which at a magnification of 8 gives a scanning zone of 3 mm. length by 0.0125 mm. width.

Projector Light Sources.—Data on new projector lenses are very meager for the past six months. At the Eighth International Congress held in Dresden in August, Joachim presented a comprehensive paper dealing with optical systems for projection.

An effort to meet the demand for a portable source of illumination of greater brilliancy is indicated by the introduction of a new low amperage projector lamp designed to operate on 115 volts a-c. current at a maximum of 15 amperes. A compact portable full wave rectifier provides direct current for its operation. Automatic trimming is afforded by a differentially wound motor.

Non-intermittent Projection.— A non-intermittent projector for very thin (cellophane) film was demonstrated successfully in Madrid, Spain. The film has a row of perforations along one side and the sound track is printed along the other border. Since the film moves continuously, the sound record does not have to be displaced from the picture but runs alongside each picture.

Screens.—A new sound screen recently demonstrated in London consists of a special fabric upon which small semi-parabolic lenses ⅜ inch in diameter are mounted with a special light reflecting cement. The spaces between the lenses are cut away. A screen 22 ft. by 17 ft. carries about 460,000 lenses.

In a new type of reverberation meter supplied by Electrical Research Products, Inc., sound energy is converted to electrical energy and a series of points are recorded on a waxed paper drum which give graphically the exact history of the sound decay.

Applications of Motion Pictures.—Extensive plans are underway in Japan for expansion of the uses of motion pictures in education. Substandard film is now in wide use in the schools. There are over 300,000 teachers in the empire's 45,000 schools housing 12 million pupils. A program of 180 pictures is in progress for school and general educational use under the direction of the Ministry of Education.

Drawing or free-hand sketching from motion picture films is becoming more and more an accepted practice in art schools. Commercial classroom films are now available for this work.

Sound motion pictures have been offered as evidence of unpleasant noises of an Australian dairy company's workman which disturbed the sleep of the plaintiff. In obtaining the record, a microphone was placed a few inches from the windowsill in the plaintiff's bedroom, and an ordinary voice recorded for comparison purposes.

Television Systems. — Short has published details on a television direct pickup camera, in which the image of the person being televised is focused directly upon spiral number one of the scanning disc. The camera is mounted on a rubber-tired truck which runs under its own power. Detailed movement of baseball games, tennis matches, and airplanes in flight have been followed easily with the apparatus, and it is possible to move quickly from a "close-up" to a "long-shot."

At the end of each scanning cycle in the Barthélemy system, the beam is interrupted a very short time. These lapses produce a 480-cycle frequency, which, filtered by an ingenious amplifying circuit, is used to operate a synchronous motor which

(*Continued on page* 38)

Theory and Fundamentals

By W. W. JONES

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Engineering Department of RCA Photophone and has been closely identified with the educational activities of that organization since the time of its inception. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that institution.—THE EDITOR.

Matching the Loudspeaker and the Amplifier

BECAUSE sound is emitted from the loudspeaker, the loudspeaker usually receives an undue amount of criticism particularly when that sound is not satisfactory or pleasant to the listener. Sound may be unsatisfactory because it lacks volume or because there is distortion present. This lack in volume or distortion of signal does not necessarily mean that the speaker is at fault. The speaker may be entirely satisfactory and yet produce unsatisfactory results if it is not properly matched to the amplifier.

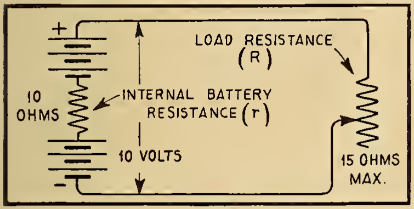


Fig. 1

For the purpose of discussion, the question of volume or power, and distortion will be considered separately. If we are to use efficiently the power available from the amplifier, it is necessary that the speaker be properly matched to the output of the amplifier. It is to be observed at this point that the question of matching the speaker to the amplifier involves the problem of distortion as well as power. Accordingly, the problem of distortion is not to be forgotten during the discussion of speaker matching for maximum power output.

Maximum Power Output

Maximum power output may be obtained from the amplifier when the load impedance of the amplifier power tube is equal to the tube plate impedance. This statement has been found to be true in practice and can be shown to be true by the following simple electrical analogy:

Assume a variable resistance load (R) is placed across a 10 volt battery as shown in Fig. 1. Now assume the battery has an internal resistance (r) of 10 ohms. The resistance (r) has been drawn in the figure to represent internal resistance, and it corresponds in this analogy to the plate impedance of a vacuum tube. The resistance load (R) corresponds to the load impedance of a vacuum tube. The 10 volt battery corresponds to the voltage output of the tube. All of the values of volts and ohms selected are arbitrary and the results, of course, are independent of these values.

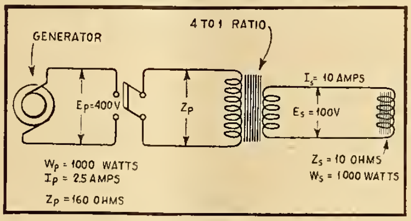


Fig. 2

The tabulated data below is obtained as follows: Assume a load resistance (R) equals zero. The current in the circuit then equals (from Ohm's Law) volts divided by ohms or 10 divided by 10 or 1 ampere. Then, the power across the load circuit equals the current squared times the load resistance (R) or 1 ampere times 1 ampere times zero ohms or zero watts as shown by the table under the heading Load Power.

As a further example, assume a load resistance (R) equals 10 ohms. The total resistance of the circuit equals (r) plus (R) or 10 ohms plus 10 ohms or 20 ohms. The current in the circuit then equals volts divided by ohms or 10 divided by 20 or 0.5 amperes. The power across the load circuit equals 0.5 squared times 10 ohms or 0.25 times 10 or 2.5 watts.

The remainder of the data can be calculated in a similar manner.

Load Resistance (R)	*Battery Resistance (r)*	*Load Power*
0	10	0
2	10	1.39
5	10	2.22
10	10	2.50
15	10	2.45
20	10	2.22
50	10	1.39

By examination of the above tabulated data it can be seen that the power delivered to the load resistance (R) by the battery is maximum when the load resistance (R) is equal to the battery resistance (r). Accordingly, in the operation of a vacuum tube circuit the tube load impedance must be equal to the tube impedance when maximum power delivered to the load is desired.

It is stated above that it is necessary to match the loudspeaker to the amplifier to prevent distortion. The above explanation on maximum power does not apply to maximum undistorted power, because it is necessary to sacrifice power in order to prevent distortion. In the case of loudspeaker and amplifier matching the load impedance is adjusted equal to two times the tube plate impedance, when maximum *undistorted* power is desired. While this statement has been shown to be the true both in theory and in practice there is no simple explanation for it available as in the case for maximum power.

Impedance Matching Transformer

There are several means of coupling electrical circuits for proper impedance matching. However, it is common practice to couple the loudspeaker to the amplifier by means of a coupling transformer commonly known as an output transformer. Since this is true, only transformer coupling will be considered. In order to appreciate the meaning of impedance matching and in order to demonstrate the use of a transformer as a device for impedance matching, the following explanation is given:

Fig. 2 represents an ordinary A. C. lighting power transformer which reduces the voltage from 400 volts to 100 volts. By examining the figure it will be noted that the secondary load impedance on the transformer is 10 ohms, and the power consumed is 1000 watts. We also note that the ratio of the transformer is 4 to 1, and that the power (W^p) in the primary circuit must be 1000 watts, the same as in the secondary circuit.

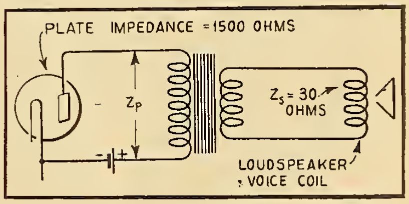


Fig. 3

Let it be required to find, first, the primary current (I^p) and, secondly, the primary load impedance (Z^p) so that the effect of the transformer on the secondary load impedance (Z^s) can be determined.

The primary current,

$$I^p = \frac{W^p}{E^p} = \frac{1000}{400} = 2.5 \text{ amperes.}$$

and the primary load impedance,

$$Z^p = \frac{E^p}{I^p} = \frac{400}{2.5} = 160 \text{ ohms.}$$

The primary load impedance (Z^p) connected across the generator as determined above is 160 ohms, whereas

(*Continued on page* 40)

Patents:

A series of instructive and interesting articles on how patents are obtained and sold.

By RAY B. WHITMAN

NOTE: *In this series of articles Mr. Ray B. Whitman, practicing patent attorney of New York City, explains in understandable non-technical language, just what a patent is, how one is secured and how it may be sold. In addition, Mr. Whitman offers to the readers of this magazine personal advice without obligation on any subject connected with patents, trademarks, designs, or copyrights. All inquiries should be addressed to Mr. Whitman in care of this magazine.*—EDITOR.

ANOTHER and additional means of delaying the issue of the patent is to prosecute the case to an allowed condition and then not to pay the final fee of $20 within the six months permitted. The case then becomes forfeited, but can be renewed within one year from the end of this time. Thus it may be again prevented from issuing for an appreciably longer interval.

As long as the application is pending, it is held *in secrecy* in the files of the Patent Office, and the inventor is in position to watch the activities of his competitors and issue it only when he needs it to protect his rights. By means of this strategy, the seventeen-year term of the patent monopoly is arranged to begin more nearly on the date that the patent is really needed. Once issued, it can only be extended beyond that term by an Act of Congress; but such extension has never yet been granted on any mechanical patent. However, as a partial substitute, the inventor may sometimes keep his protection alive by filing other patents from time to time on improvements of the original invention.

Still another advantage of delaying the issue of a patent is that it often enables the inventor to dispose better of his rights by sale or license, since most large corporations or other purchasers have been taught by their attorneys to give preference to the purchase of patent rights as yet in the application stage. For it enables these attorneys to correct or augment the work of the inventor's attorney by revision or by adding new claims during the original prosecution. Otherwise, if this is not done, the purchaser must either be content with the protection of the original patent, or else try to broaden it by filing an application for "reissue."

Reissue Patents

Among the thousand or more patents which issue each week, are many which are seriously defective, because they do not broadly or fully claim the inventors' ideas. This may be caused by the varying ability of the different attorneys in broadly viewing the inventions in a practical way, and then in broadly claiming them; or it may be due to the inventor's lack of cooperation with his attorney, as in not providing a sufficient fee for him to take the time to prepare conscientiously and vigorously and get through the Patent Office every possible claim needed to cover adequately all of the invention.

Fortunately, however, the law permits the correction of such defective patents, to broaden them, through "reissue" patents, provided their filing is not delayed unduly and in no case beyond two years from the date of issue of the original patent. This right is of great value to inventors, and might well be taken advantage of much more often than the once in a hundred (according to statistics) that it is now. In fact, such action is often imperative before the inventor can hope to realize anything from his rights.

The original application must be forfeited when the application for reissue is filed. But this involves no particular risk, since all its valid claims may be obtained in the new or reissue patent, plus any additional ones to which it is shown the inventor is entitled. The term of protection of a reissue patent ends with that of the original patent, and the rights under it are otherwise the same. The filing fee is $30; there is no final fee; and since no new matter may be included in the disclosure, copies of the original drawings may be used.

Every one who has a patent that has issued within the past two years, particularly where there is reason to doubt its strength, might well submit it to another attorney than the one who obtained it, and have him study the file to determine if a stronger and more valuable patent may not yet be obtained by reissue. But get an attorney with a successful record in reissue cases, if possible, since broadening a patent is a more difficult task, and requires more ability and knowledge of patent law, perhaps, than does the obtaining of the original patent.

To Avoid Abandonment Risk

An inventor should be ever alert to guard against loss of his patent rights through what is known as "abandonment." This may occur in various ways, the more common of which are:

(1) the inventor's delay in filing his application for more than two years after his invention is in public use; and

(2) the failure—usually through his attorney, but for which he is responsible—to cover fully by claims all of his invention as disclosed in his specification and drawing. For such a failure results in a dedication to the public of his rights to the unclaimed parts.

Such an abandonment as this last, however, may, as explained above, sometimes be corrected by filing a reissue of the original patent; but if the inventor delays longer than that, he has *permanently* abandoned his rights. But in view of the risks incident to reissues, including that of "intervening rights," a subject too technical to be discussed here, the inventor should be ever concerned to see that his claims, as originally filed, are sufficient in number and scope to cover all of his invention, and that they specify completely what he wants others not to do.

Other Causes

While the above are the most frequent causes of abandonment, and result in the loss of millions of dollars yearly in patent property, other causes include:

(3) long delay, unexplained and not excusable, in the filing of the application after conception of the invention;

(4) failure to pay the final fee within six months after the date of allowance of the application, followed by failure to renew same within two years from such date;

(5) failure to copy the claims of an issued patent to another covering the same invention, within two years after that other patent has issued, for the purpose of having an interference declared with your pending application.

This last suggests the importance of instructing your attorney, at the time your case is filed, to review all patents on inventions which might be similar to yours, as soon as they issue, and to keep you informed of any which may have claims to which you alone are entitled, so that the necessary corrective action can be taken for you in plenty of time.

Frequent Misconceptions

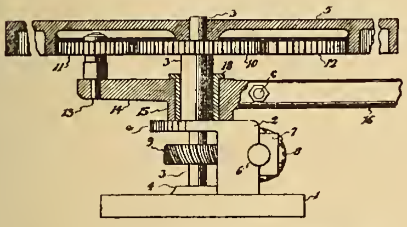
There are several mistaken ideas about patents that are quite common, and so ought here to be discussed and cleared up.

Sometimes, when a patent application is pending, the patent office allows all the claims, or nearly all of them, as originally worded, and without rejection or change. The inventor then often believes that this indicates a strong patent. On the contrary, however, it shows, in the great majority of instances at least, that the claims were worded so specifically by the attorney as not to be readable upon the prior art, which might, as

◆ RECENT PATENTS ◆

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 230 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine, and enclosing fifteen cents to cover costs.

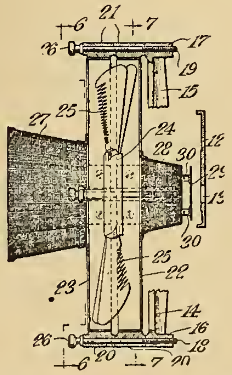
1,821,630. REGULATOR FOR SOUND REPRODUCING AND SYNCHRONIZING MACHINES. Charles H. Garrett and Bruno G. Herber, Dallas, Tex. Filed Mar. 25, 1929. Serial No. 349,539. 4 Claims. (Cl. 88—16.2.)



1. A regulating device for sound reproducing machines including a turntable having an internal gear ring, a vertically disposed shaft, a driving gear mounted upon and rotated by said shaft, an intermediate gear for transmitting motion from said driving gear to said turntable, a bushing carried by said vertical shaft, a ring having an integral arm tensionally mounted on said bushing and affording a bearing for said intermediate gear and means associated with said arm to relieve the tension of said ring whereby to rotate the latter to move said intermediate gear circumferencially relative to its points of engagement with said driving gear and gear ring.

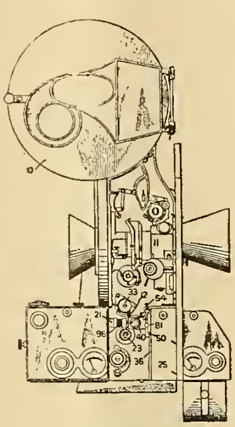
●

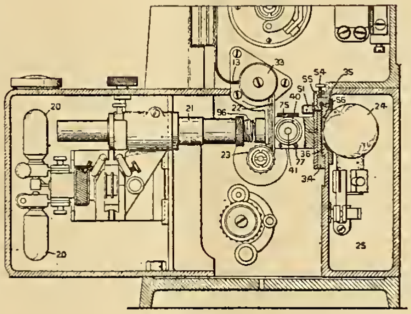
1,820,054. LIGHT GUARD FOR MOTION PICTURE PROJECTION MACHINES. Augusto Dina, Jersey City, N. J., assignor to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed Mar. 30, 1929. Serial No. 351,206. 12 Claims. (Cl. 88—17.)

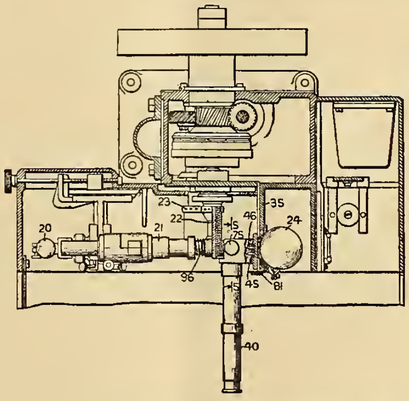


1. In a projection machine having a projection light beam, a projection head having an aperture opening upon which said beam is directed, a perforated shield around a portion of the beam adjacent said head, and an end wall to said shield, said wall extending across said beam and having an opening therein of predetermined cross-sectional area to define the area of the light beam falling upon the aperture opening.

1,823,355. TELESCOPE FRAMING DEVICE. Louis Simon Frappier and Ewald Boecking, Brooklyn, N. Y., assignors to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed June 29, 1929. Serial No. 374,761. 9 Claims. (Cl. 179—100.3)

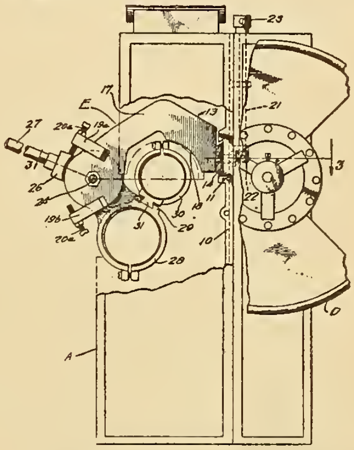






1. In a machine for reproducing sound from a photographic sound record, means for producing a scanning light, a film gate for directing said sound record past said light, a support therefor, and a microscope for facilitating adjustment of said light, means for supporting said microscope comprising a housing having an aperture therein, a prism supporting means mounted adjacent said aperture for changing the angle of the scanning light, and means for mounting said housing upon said film gate support interchangeably with said film gate.

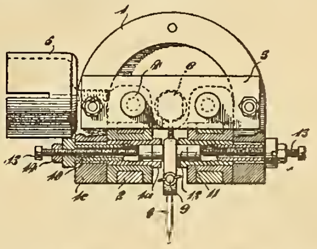
1,822,551. LENS SHIFTING MECHANISM FOR PROJECTING MACHINES. Albert Tondreau, Los Angeles, Calif., assignor to Warner Bros. Pictures, Inc., Los Angeles, Calif., a Corporation. Filed Apr. 13, 1929. Serial No. 354,810. 9 Claims. (Cl. 88—24.)



9. A picture projection apparatus comprising a motion head, a lens shifter device comprising a bracket secured to said head, a lens shifter including a first lens shell, a second lens shell having its axis spaced from and parallel to said first lens shell and secured thereto so as to be moved therealong and enable longitudinal adjustment of said shells in relation to one another, a pivotal connection between said shifter and said bracket to enable said shells to be swung to position either lens shell with its axis in alinement with the projected light, a lens shifter handle secured to said shifter and stops to define the limits of swinging movement of said shifter.

●

1,823,162. ELECTRICAL REPRODUCTION OF SOUND FROM RECORDS. Laurence Herbert Pearson and Claude Marshall, Nottingham, England. Filed Feb. 12, 1930. Serial No. 427,764. 5 Claims. (Cl. 179—100.41.)



1. A pick up for the electrical reproduction of sound from records, embodying in combination a permanent horseshoe magnet having hollow cylindrical pole pieces, said pole pieces being mounted on bracket members positioned adjacent to the two limbs of the magnet, a coil on each pole piece, a metal reed resiliently suspended between the coils, the length of said reed approximating the diameter of the coils, a screw operating axially within each pole piece, cushion elements for damping the reed located on each side of said reed and said screws functioning adjustably to determine the position of said cushions.

a matter of fact, be quite extensive; and hence the Examiner was forced to allow the claims without objection. Such an action is often detrimental to the inventor's best interests, which are better served by having some, at least, of the original claims worded so broadly as—to use an attorney's expression—"to bring out the art."

This prior art is later of great use in determining the exact validity and scope of the claims finally issued in the patent. It fixes the particular part of the inventive field to which the inventor is entitled in his patent, and also makes clear what part is old or belongs to others.

Moreover, like everything else in the world, the big prizes come from the expenditure of the gratest effort; and broad claims written into the case originally, then rejected by the Examiner, and later allowed in whole or in part after a contest with the attorney, are, in a sense, semi-adjudicated, and their validity and scope thus better maintained in case of future contest in court.

Another mistaken idea of many inventors is that the granting of a patent gives something of value in itself. But, of course, while there is a certain advertising and restraining value, as previously explained, the chief value of any patent is in the breadth of its claims. If these are only one or two in number, and comparatively long and specific in wording, as by being directed to a lot of unnecessary details, the issue of the patent may only serve to teach the invention to the inventor's competitors, and without payment of tribute to the inventor for his rights, since they are so easily avoided.

Patent Office Integrity

Another common mistaken idea, especially among poor inventors, is that there are "leaks" in the Patent Office, and the poor or uninfluential inventor may have his idea stolen from him. But there is absolutely no cause for worry on this point. The Commissioners, in active charge of the Patent Office from its founding, have all been men of the highest integrity; and a finer and more trustworthy group of men and women than the Corps of Examiners it would be impossible to find. In truth, it can be safely said that the loss of a patent right through either the Patent Office or through the larger and more professional group of patent attorneys, is practically impossible.

There is still another common myth that ought to be exploded, and that is that a patent once obtained, is only an excuse for a law suit, and that the rich corporation can infringe it with impunity unless the inventor can raise a large sum of money to prosecute a suit. However, many an inventor with a patent infringed by a large concern has succeeded in bringing suit, by employing an attorney on a contingent-fee basis, never putting up a cent himself, and eventually coming out of the litigation with a fortune. In fact, this is a quite common occurrence, and suggests this bit of advice: If you have reason to believe that your patent is being infringed by anyone, immediately report to your attorney, who will usually arrange to have your rights respected, and on some basis profitable to you. Some attorneys, of course, do not practice in this way, but you can often find one who is enough of a friend and humanitarian, and not too busy to help you.

Analysis of Real Protection

Although none but an expert in patent matters can sense the scope and probable validity of a patent, there is a simple way for everyone to get a remarkably reliable idea of how good an *average* patent is. Hence this chapter, which should be of great value not only to inventors, but to manufacturers and investors who are interested in the purchase of patents, and hence need a reliable gauge of their probable value. The method of analysis is a new one, conceived by the author, and published here for the first time. It is the result of an analytical study of many hundreds of patents. It may be stated briefly as follows:

1. This method is based upon the Law of Averages, which is found to work here with reasonably complete accuracy and dependability when not less than six or eight patents are being considered. For a lesser number, this method of analyzing their real protective value, although always a valuable index, is less reliable, it being then merely presumptive rather than conclusive.

2. The shorter the claims are, the broader they are, as an average condition, this being previously explained in another chapter. For purposes of convenience, the average number of printed lines in each of the three shortest claims in each of the patents under investigation, is first noted. The average of these averages is then found for all the patents by dividing their total by the total number of patents. If this average is 7 or 8 printed lines, or less, it usually indicates reasonably good breadth in the scope of the important claims of those patents; but if this average is several printed lines in excess of that, or more, it suggests the presence either of unnecessary limitations in the claims or else of claims drawn to very specific combinations of inventions which are mostly old and so protectable by patent only in a very specific and therefore valueless way.

3. The sum of the total number of claims in every patent, divided by the number of patents considered, gives the average number of claims per patent of all the patents. This average, for the average patent among the thousand or so issued each week throughout the year, is about 7 claims per patent. Now, if the average for the patents being analyzed is less than 7, it usually suggests only partial protection of little value. But if the number is considerably more than 7, it is an index that many patentable combinations of the invention have been covered in the claims, and some real surrounding protection therefore obtained. This, coupled with an index of broad short claims, as previously explained, presumes a patent of much more than average value.

It is a simple matter for an inventor to use this method of analysis when first employing at attorney, by analyzing that attorney's previous work in taking out patents; also in checking up the patents being obtained for him by his present attorney to determine not only how novel his inventions really are, but also how skillful his attorney's work appears to be. This method is, too, of great value to corporations in determining how their own attorney's work compares with that of their competitors. Finally, it is frequently of use to investors of patent rights as a good index on patent value during the preliminary negotiations, and before going to the expense of getting their attorney's studied opinion prior to contracting for the purchase of license of such patent rights.

(*To be continued*)

E. E. Shumaker Resigns as President of RCA Victor

Mr. David Sarnoff, president of the Radio Corporation of America, has announced the resignation of Edward E. Shumaker as president of its subsidiary, the RCA Victor Company.

The resignation was accepted by the RCA Victor Company board to become effective as of January 1, 1932.

Mr. Sarnoff stated that it had been Mr. Shumaker's desire to retire from active business when the Victor Talking Machine Company, of which he was president, was purchased by the Radio Corporation of America. At Mr. Sarnoff's request, however, Mr. Shumaker had agreed to accept the presidency of the new RCA Victor Company which was formed in 1929 as a result of the merger and to serve in that capacity until the problems incident to unification had been solved and the reorganization completed, which has now been done.

Mr. Shumaker's resignation brings to an end twenty-eight years of service in the home entertainment industry, he having joined the Victor Talking Machine Company in February, 1904.

In retiring from the industry in which he has spent his entire business life, Mr. Shumaker predicts even greater accomplishments for its future.

Report of the Screens Committee

The report which follows presents the findings of the Projection Screen Committee of the S. M. P. E. The Committee is composed of S. K. Wolf, Chairman, and the following members: D. S. De Amicis, F. M. Falge, H. Griffin, W. F. Little, A. L. Raven, C. Tuttle and D. F. Whiting.—THE EDITOR.

THE Projection Screens Committee commenced its operations in March. The first meeting was held on April 16th in New York, N. Y., at which the Chairman submitted a preliminary outline of the work proposed for the Committee to undertake. This outline was discussed and elaborated and as a result a second and more detailed outline was prepared and distributed among the members. The second meeting was held on May 14th. This preliminary report is based largely on material submitted and examined at that time.

The main lines of endeavor are outlined as follows: Manufacture of Screens, Mechanics, Light Reflection Properties, Sound Transmission, Illumination, and Rear Projection Screens. Responsibility for the different sections has been assumed by the members with regard to their familiarity with the different fields. Considerable data will be collected on light reflection properties, brightness values of screens in theatres, and manufacture, installation, and maintenance of screens. It is also hoped that the Committee will be able to make recommendations as to the type of screen to employ under specified conditions of use.

The following is in the nature of a preliminary report and, therefore, is not as complete and conclusive as we should like it to be. Nevertheless, it is our opinion that it offers material which the Society may find of interest at the present time and will indicate what may be looked for in our later report.

Bases.—The manufacture of sound screens is a critical undertaking in which all details must be given due consideration in order that uniformity and high quality of finished product may result. Most screens employ a fabric as a base although there are some which employ a metal. Essentially, the purpose of the fabric is to provide the necessary strength for the screen and to serve as a carrier for the light reflecting surface. Quite often the fabric is coated with a cellulose compound and the combination employed as a base.

With some screens a slight translucency of the fiber from which the fabric is woven is desired. This is the case when the rear surface of the screen is colored in an attempt to impart to the reflected light a slight tone of the particular color used. It is more customary, however, to make the fabric as nearly white and opaque as possible in order to improve its light reflecting qualities.

Surface Treatment. — The base fabrics are treated in various ways to give various reflection characteristics to the screens. The surfaces are classified as matte or diffusing, beaded, or metallic, the latter two being somewhat directional in their distribution of illumination. They may be applied by a knife spreader process, by printing with rollers, or by spraying or painting. Great care must be taken to secure a uniform and sufficient thickness of coating to provide good light reflection characteristics while staying within the limits imposed by other conditions. As yet, no detailed information has been collected in regard to the materials which are commonly used for surfacing.

It is present practice to color the backs of screens for purposes of identification. As mentioned before, however, color is sometimes used with thin surface layers to provide a slightly selective reflection characteristic.

Materials for coating vary greatly in their properties. Some diffusing screens are slightly glossy and others have perfectly flat white surfaces. Flat white seems best for avoiding surface glare and undesirable reflection at the seams. Diffusing surfaces may be hard or soft, smooth or rough. A hard smooth surface without sheen is apparently desirable since it is less apt to collect dirt and is easier to clean. Beaded screens require ingredients to hold the beads firmly in place. Most surfaces are formed from pigments and gums, oils, or other binders. In general, the gums and oils cause screens to become yellow with age.

Fireproofing.—At various times there has been agitation in regard to fireproofing of screens. This situation grew out of the practice of using highly inflammable nitrocellulose bases. Screens of this type are undoubtedly fire hazards and their use has been largely discontinued. At present, practically all screens are either slow-burning or fire-resistant. They are made so by properly selecting the materials and by flameproofing the base fabric prior to treatment of the surface.

This Committee has found that it is impossible successfully to fireproof a screen after manufacture or when in place in the theatre. It must be remembered that the screen is a small item in the stage equipment of a theatre, that it is usually much less inflammable than the surrounding draperies, and that usually it is hung vertically and stretched tight, so that it is not likely to be the cause of fire. We know of no case in which slow-burning or fire-resistant screens have caused fires.

In general, it devolves upon the exhibitor to make his choice of screens, depending on his own local ordinances and conditions. The Committee is considering a recommendation relative to the marking of all screens which have been flameproofed so that difficulties arising in this connection may be eliminated.

Sound Requirements.—After many tests, the necessary requirements as to the ratio of open to solid space in sound screens have been determined by producers of sound equipment,

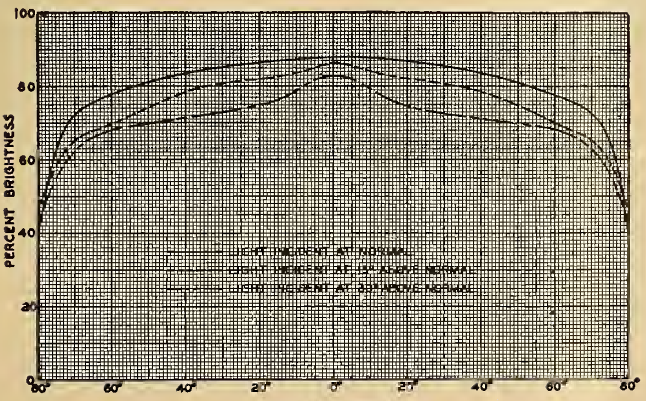


Fig. 1. Distribution of Brightness in Horizontal Plane for Diffusing Screen

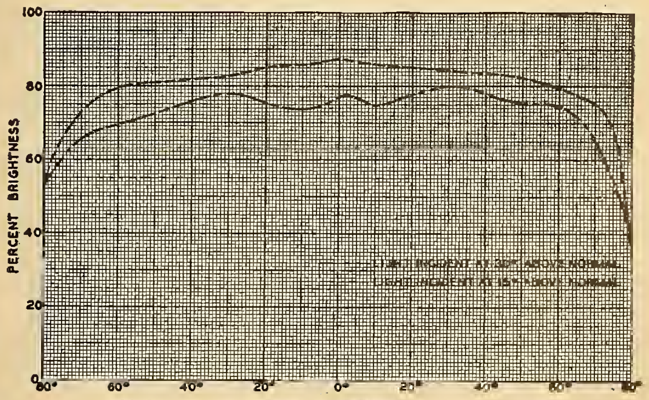


Fig. 2. Distribution of Brightness in Vertical Plane for Diffusing Screen

and screen manufacturers have guided themselves accordingly. Screens of the perforated type in present use have a ratio of open to solid space of approximately 8 per cent; screens of the porous type have a rather larger ratio. Acoustic theory indicates a minimum of 5 per cent as desirable. Perforations generally are made after the screen is surfaced.

Seams.—In assembling screens the seams should be placed vertically. Care must be taken not to stretch the screens too tightly. Butt joints are used with some metallic and beaded screens employing cellulose coated fabric as the base but are not generally used with others.

Mechanics

Size.—The distance between the front row of seats and the screen is one determining factor for the size. The larger the picture, the more plainly imperfections in the film, such as graininess, show up. This is very noticeable and objectionable in the nearer seats. Also, since the eye can satisfactorily accommodate itself to movement throughout a 60-degree angle, the distance between the front row and the screen should approximate 0.87 foot for each foot of screen width. For a 15-foot picture, a distance of at least 13 feet should therefore be provided.

The size of picture should be determined by its distance from the rear seats. The width of the screen should be equal to approximately one-sixth the distance from the screen to the rear seats. For a distance of 120 feet, therefore, a 20-foot picture should be used, provided there are no seats nearer the screen than 17 feet and the projection angle is not very great. These rules are intended only as guides.

The standardization of sizes is of primary importance to both manufacturer and exhibitor. Many errors are made in ordering screens because of confusion in description, resulting in considerable monetary loss. Sizes have already been standardized by several manufacturers and large users, but not always in the same way. The Committee is considering for recommendation a set of dimensions to be used as standards and sub-standards.

Mounting. — Each manufacturer should determine the best method for mounting his own screens and advise purchasers accordingly. By taking proper care in mounting the screens, damage and cost of installation can be reduced considerably. A survey of instructions sent by manufacturers may lead to general rules. These may be drawn up into a revised instruction sheet for consideration by manufacturers.

Masking.—The usual masking is black. This results in a very marked frame which reduces the effect of "jumping" of the picture caused by the film or projecting equipment. It has been felt that the resulting contrast is too great and various persons have advocated an intermediate gray. We are considering a suggestion that the mask be graded from black to lighter grays with the black edge next to the picture.

Deterioration.—All screens deteriorate with age: "silver" screens tarnish, other types become yellow. Yellowing of the surface is accompanied by a reduction in reflection value and by an undesirable color tone which is imparted to the picture. Yellowing is usually caused by gums and binders and not by the pigments. We are informed that of late there has been marked improvement in this respect.

In addition to discoloring screen, accumulated dirt also causes a deterioration of reflecting qualities. The amount of dirt collected depends on the condition of the air in the theatre, the precautions used to protect the screen, and the nature of its surface. It is essential that draperies surrounding the screen be cleaned regularly and that circulation of air through the openings of the screen be prevented. If possible, it should be enclosed when not in service, even though with the cheapest kind of material. The average useful life of a sound screen varies from one to two years, depending on the conditions of use.

Cleaning.—Even with these safeguards the screen will gather dirt. An examination will indicate whether the dirt is dry or oily and, therefore, whether the screen may be brushed or not. If brushing is permissible, a long handled special brush should be obtained and the screen brushed once a week. It is also helpful to use a vacuum cleaner on the rear surface. More thorough cleaning should be done by experts who have sufficient scientific knowledge of screen materials to devise safe and suitable methods. Furthermore, certain types of screen cannot be cleaned satisfactorily at all. Each manufacturer should advise the users of his screens as to the possibilities.

Reprocessing. — Renewing of the surface of diffusing screens by spraying is receiving considerable attention. When carefully done and when the proper materials are used, completely satisfactory results seem to be attainable. The spraying pigment should be highly reflecting, should not fill up perforations, and should not become yellow with age. The screen and surroundings should be thoroughly cleaned before the processing is undertaken. Such a renewal of the surface is not feasible on all types of screens.

Light Reflection

Total Reflection Factor.—There are several ways of defining the total reflection factor, based on the methods of test used in different laboratories. The laboratory which makes most of the commercial measurements of screen reflection characteristics employs a method in which the light is incident on the test sample from all directions within a cone of 180 degrees. The angle of observation is 12 degrees from the normal, and the light returned in this direction is taken to indicate the total reflection factor. The Committee advocates the adoption of this definition as standard.

Angular Distribution.—One of the most important attributes of a screen is its ability to reflect the incident light to the observers. Angular distribution curves in the past have been obtained with light at normal in-

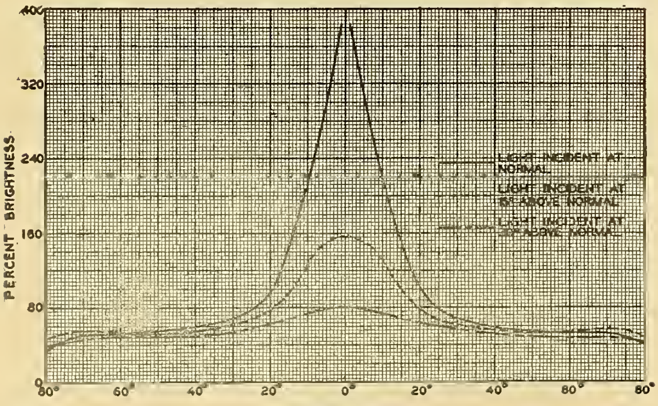


Fig. 3. Distribution of Brightness in Horizontal Plane for Beaded Screen

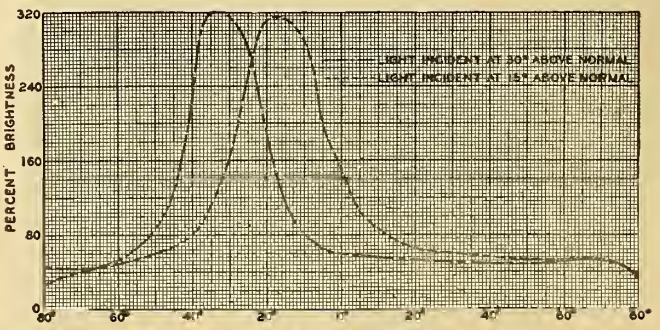


Fig. 4. Distribution of Brightness in Vertical Plane for Beaded Screen

cidence. Data collected by this Committee show that the average projection angle is approximately 15 degrees, measured to the perpendicular to the screen. Therefore, we believe that measurements with light incident on the test sample 15 degrees above the normal will give information more in keeping with conditions of actual practice. The reflected light would be measured in a horizontal plane and in a vertical plane containing the light beam, both normal to the screen sample. A more complete discussion of this question will appear in our later report.

The accompanying curves, Figs. 1-6, illustrate the variation in distribution of light at three angles of incidence, 0, 15, and 30 degrees from normal. It will be noted that with a smooth diffusing type of screen the difference between measurements at zero and the other angles is appreciable but that the distribution is relatively uniform. In the horizontal plane, there is considerable diminution of reflected light and some equalization in distribution for both beaded and metallic types. In the vertical plane for a beaded screen it is a distinguishing feature that the axis moves to follow the incident light beam so that a good portion of the light is reflected back upon itself. With a metallic screen, the axis is at the specular angle. It its planned to make recommendations for the types of screen to be employed in theatres of different architectural design, as is now being done to some extent, but as yet the Committee is not ready to go on record with definite suggestions.

Variation across Screens.—Because of non-uniform light incidence over the total area of the screen and because of the non-uniform reflection characteristic, there will usually be variations of brightness in a projected picture. All theatres are subject to this effect at the front of the house but, of course, the continuous change of intensity in the pictures reduces its noticeability. We shall propose limits for allowable brightness differences.

Sound Transmission

Theory.—The design of screens from the standpoint of sound transmission presents problems which are simple in comparison with optical considerations. The great importance of good sound transmission characteristics should, however, be recognized. An analysis of the general problem of transmitting sound through a material such as a screen indicates several possible methods; certain practical considerations, however, limit the designer to the use of two. A screen may be expected to radiate sound as a result of being set into vibration by sound impulses emanating from the loud speaker immediately behind it, or the sound impulses may be transmitted through the air spaces in the screen material.

Types of Air Spaces

These air spaces may simply be those due to the porosity of the material itself, but better control of the transmission characteristic may be effected by deliberately providing air passages of the proper size and number. This may be accomplished by careful weaving, punching, or other means. All commercial types of screen depend largely upon this method of transmission although many depend upon the diaphragm action of the screen to overcome a loss which may occur at low frequencies due to a decrease in the radiation resistance of the air passages in this part of the frequency range.

Because of the desirability of affecting the optical characteristics of the screen to as small an extent as possible, the perforations or air spaces in the screen are made as small as is practicable and their number is limited to the absolute minimum. Fortunately, it is possible to obtain quite satisfactory sound transmission by using rather small, widely spaced openings which, in the aggregate, offer a comparatively small total open area in the screen. It is felt that an aggregate open area amounting to 5 per cent of the total screen area may be considered tolerable from the light reflection standpoint.

On this basis it is found that the sound requirements may be met without impairing the detail of the picture. The relations between the screen thickness and the size and number of the holes may be worked out rather easily by applying the known acoustical theory; an approximation will serve, however, for the practical designer.

For perforated screens it has been found, in general, that if the diameter of the perforations is equal to three or four times the thickness, the aggregate area of the openings being 5 per cent of the total screen area, satisfactory results may be obtained. This applies to the usually used materials and, of course, must at present be considered true only for them. Furthermore, it applies only over a limited range of screen thickness. This relation shows that it is desirable to keep the screen thickness at as low a value as is mechanically and optically practical.

Test.—It is the present practice to measure the sound transmission characteristics or response characteristics of each type of screen before approving it for use with sound projecting equipment. Although there are various methods by which these acoustical measurements may be made, the commonly used method involves response-frequency measurements of the output of a loud speaker with the screen placed before the speaker in its normal position and with the screen removed.

In order to adhere as closely as possible to actual field conditions in making these measurements, a loud speaker of the type used in the field should be employed. Since this method of test approximates closely the theatre conditions and since it includes the effect of the diaphragm action of the screen, if present, it is probably the most desirable method of making the measurements. The response measuring technic should conform with accepted loud speaker response measuring methods.

Tolerances.—There are three factors which must be determined before a proper judgment of screen performance may be made. The general loudness attenuation effect, the frequency range for sound transmission, and the regularity of frequency response all enter into the determination of the suitability of a screen from the acoustical standpoint. In general, little trouble is experienced in obtaining efficient low frequency

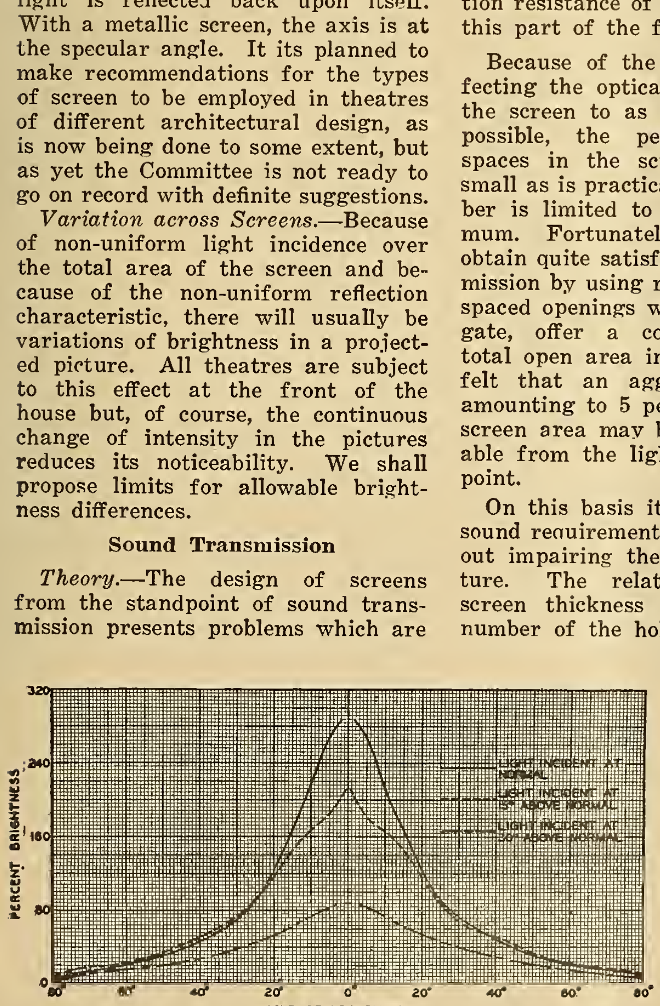


Fig. 5. Distribution of Brightness in Horizontal Plane for Metallic Screen

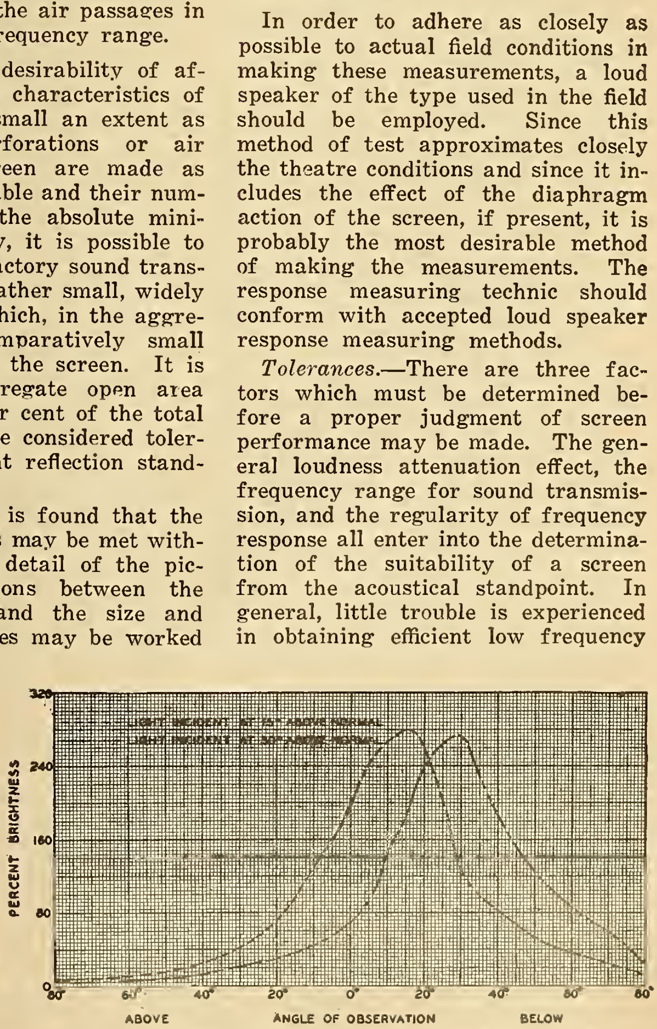


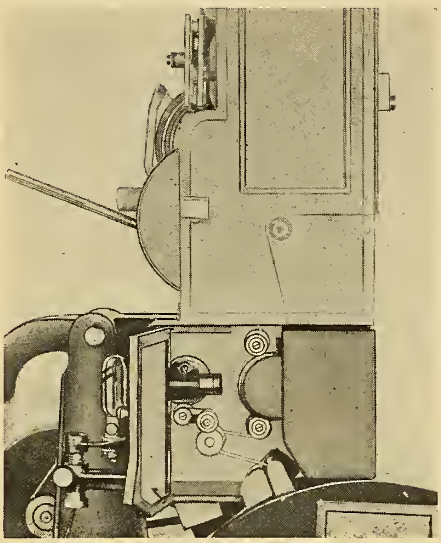
Fig. 6. Distribution of Brightness in Vertical Plane for Metallic Screen

response. Usually, however, screens exhibit a drooping characteristic at high frequencies.

Since the droop at high frequencies is usually rather gradual, no definite frequency range may be assigned to the screen response; the allowable loss at certain high frequency points relative to the 1,000-cycle response should be specified. On the whole, it must be observed that it is difficult to set absolute limits for screen response, covering all possibilities. The following have been applied successfully to the great majority of cases by the two largest manufacturers of sound equipment:

A loss of 2.5 db., as given by the average response curve, at 6,000 cycles, relative to the 1,000-cycle response, is considered a desirable limiting value for existing types of sound equipment. Screens that meet this requirement are usually found to attenuate less than 4 db. at 10,000 cycles. As to regularity of response, variations greater than ± 2 db. would not be tolerable. Because of standing wave effects in the measuring room, inaccuracies of measurement may occur, causing variations somewhat greater than this below 300 cycles. It is felt that no limits for regularity should apply below this frequency.

(To be continued)



SYNCROFILM MODEL J SOUND EQUIPMENT

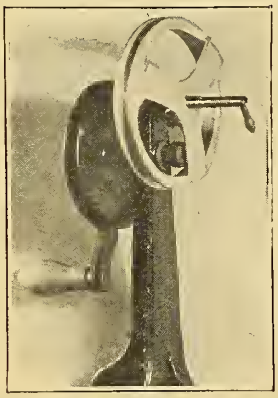
Weber Machine Corp. was first to recognize the needs of the small theatre for a first class sound equipment equal to the best, but at a price in keeping with its abilities to buy and still keep reasonably on the black side of the ledger.

Weber Syncrofilm quality has been recognized from the very beginning. It is among the leading sound equipments, yet is sold at a low price and absolutely free of all extra charges, such as service, fees, etc.

Model "J" is the most advanced. It is already in daily use in many projection rooms throughout the country.

$275.00 *per pair*

WEBER MACHINE CORPORATION
59 RUTTER STREET, ROCHESTER, N. Y.
Export Department: 15 Laight St., New York City.
Cable: "Ariab," New York



Complete your booth equipment with a

"BEST" REWIND PULLEY

Takes the place of space collar on reel shaft—Crank is not removed.

Price $2.50 at your dealer

Manufactured by

BEST DEVICES CO.
2108 Payne Avenue, Cleveland, O.

MR. PROJECTIONIST:

Good projection is up to you. Insist that the screen is kept in first class condition. You know the best equipment is useless if the screen is old or dirty.

After all, good Projection is only as good as your Screen . . . Our Screens "clinch" good projection.

A Screen for Every Type of House

Chromolite Sound Screen Non-Glare • Diffusive — The Hallmark of Quality and Service — Vocalite Sound Screen Crystal Beaded

BEADED SCREEN CORP., Roosevelt, N. Y.
Write for Samples and "Getting the Light You Pay For"

A Name that Commands Respect

Each year adds an abundance of good will and respect for the name—Vallen. And this is as it should be—the reward of 16 years effort in making stage equipment equal in operating efficiency and correlated to the projection equipment.

The name Vallen on any piece of equipment is an assurance of the finest and most practical equipment money can buy.

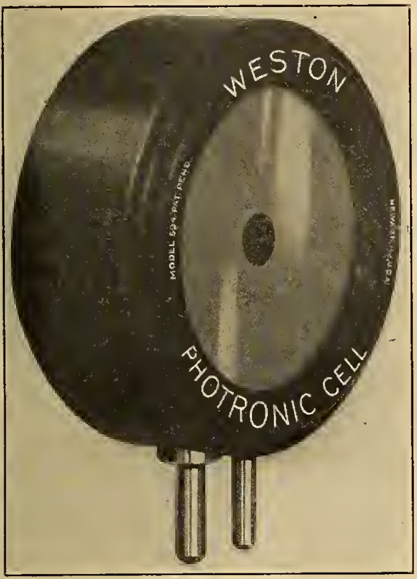
VALLEN
ELECTRICAL CO. INC.
AKRON, OHIO

Manufacturers of Vallen Syncontrol; Vallen High-Speed Curtain Control; Vallen Junior Control; Vallen Automatic Screen Modifier; Vallen Noiseless All-Steel Safety Track; Vallen Curved Track; Electrical Awning Operator; Electrical Window Shade Operator; Midget Control for Display Window Curtains; Vallen Adjustable Volume Ventilating Fan.

VALLEN
DARES TO GUARANTEE

New Equipment and Appliances

New P. E. Cell



FOR many years photoelectric cells have been serving an extremely useful mission in experimental and industrial work in controlling the operation of apparatus and equipment, in controlling various processes and in many counting operations. A number of different type cells have been available for experimental, commercial and scientific applications, each type, however, had its own inherent limitations in operating performance or had to be used in conjunction with expensive auxiliary equipment.

The discovery of an ideal type of photoelectric cell has been the subject of continual scientific research. To be of the most practical value the cell sought after should combine all the good qualities of existing cells with none of their shortcomings or limitations. Such a cell would be truly ideal but its successful attainment has been a baffling scientific problem.

The development of the Weston Photronic Cell, with its amazing performance characteristics and its utter simplicity of design marks a sensational advance and fulfills the need for an ideal type of photoelectric cell. Notwithstanding the superiority of this photronic cell, it is exceptionally low in cost as is also its auxiliary apparatus. Its discovery now places photo cell equipment well within reach of every amateur experimenter.

Electronic in its character, the Weston Photronic Cell employs a highly light sensitive disc which transforms light energy directly into electrical energy without the use of any auxiliary voltage whatsoever. Its response to light variations is instantaneous and sufficient current is developed to operate directly Weston relays without the use of auxiliary apparatus or any battery. It delivers about one microampere per foot-candle of light intensity. When exposed to direct sunlight the output is approximately 5 milliamperes. The cell resistance varies from about 1,500 ohms for 10 foot-candles light intensity to about 300 ohms for 240 foot-candles intensity.

As far as is known, the life of the cell is practically unlimited and a continuous current flow does not harm it in any way. Since it does not contain any liquid nor require vacuum or gas, there is nothing to get out of order as it is not subject to physical or chemical change and it has a constant output. It can be exposed to direct sunlight without deterioration, has no dark current since its energy is derived directly and only from light; no drifting, hence no circuit adjustments are necessary; no fatigue and it is non-microphonic.

The photronic cell is enclosed in a handsome moulded black bakelite case fitted at the bottom with two connection prongs which fit into the standard UX radio tube socket. It is rugged in construction and is so simple in design that there is nothing to get out of order. The case is 2¼ inches in diameter and 1 inch in thickness.

New Changeover Signal

A new product just being introduced by the GoldE Mfg. Co., Chicago, Ill., after seven months' operation in many theatres, is the GoldE Three Alarm—a great help for projectionists—a boon to theatre owners and of immediate interest to every movie-goer.

The GoldE Three Alarm was developed for a great need. With the GoldE Three Alarm in the upper magazine of all projectors, and with the Standard Release Print, the projectionist is aided in making exact changeovers.

Without going into technical discussion—The GoldE Three Alarm affords the projectionist three separate and distinct warnings—each at an exactly predetermined spot and at exactly the right spot for (1) general warnings, (2) start motor, (3) changeover. This is accomplished by a novel mechanical device, simple in installation and simpler in operation. Positions may be set off according to each projector's pickup speed. Micrometers once set need never be varied. Shows run off smoothly because there is never any doubt as to Start Motor Time or Changeover Time.

Marking, punching, cutting, scratching of film, is absolutely done away with. The projectionist need never fear that the wink of an eye will lose the motor or changeover cue. The GoldE Three Alarm takes the place of the regular reel end alarm—is easily and quickly installed and is of nominal cost.

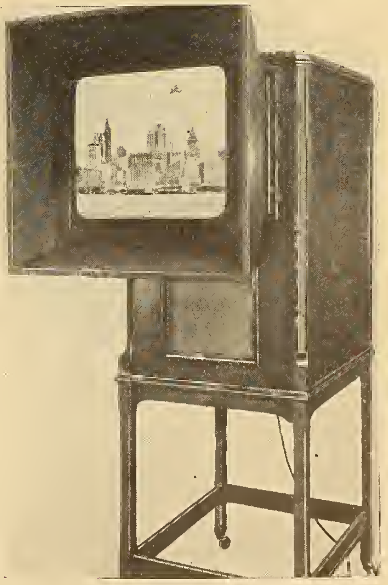
Novel Advertising Projector

A NEW sound-on-film advertising projector has just been placed on the market by the Auto Cinema Sales Company of New York. The equipment is designed for use with 35 mm. film and is housed in an attractive cabinet which stands about 5 feet 6 inches high and is approximately 3 feet square.

The apparatus comprises RCA Photophone sound equipment and a projector supplied with an endless, frictionless re-winding device, invented in Germany, by means of which continuous projection is secured. So simple is the operation that once the projector is started, it will perform and repeat without interruption and without further attendance.

The projector, sound pickup, amplifier, motor and 6 inch loudspeaker forming the outfit operate as a single unit from power supplied from a lamp socket. The picture is projected upon a transparent daylight screen 18 by 22 inches, located "top front" of the cabinet.

Among the features claimed for the apparatus, in addition to those already mentioned, are: no wear on film, absence of tension eliminating the possibility of film breakage, and maximum advertising return for minimum cost.



Report of S. M. P. E. Progress Committee

(*Continued from page* 28)

drives the receiving scanning disc. A 3-watt neon lamp is used for a picture area of 600 sq. cm. as opposed to a 250-watt lamp for a 6 sq. cm. area in certain other systems.

General Recording. — Stroboscopic motion pictures of the angular transients of synchronous motors have been taken by Edgerton with the aid of a mercury arc thyratron. Possible applications are the study of the claw mechanisms of high speed cameras and projectors or the valve spring action of gas engines.

THEATRE EQUIPMENT
NEW AND USED

Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.

Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.

We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.

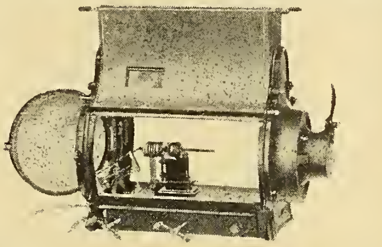
Everything for the Theatre—Write for Catalog K.

OVIE SUPPLY CO., 844 So. Wabash, Chicag

STRONG

WHAT GOOD IS A BEAUTIFUL THEATRE

If you haven't Proper Projection?



STRONG

High Intensity Automatic Reflector Arc Lamp

Eliminates the troublesome relay arc control, is economical of current and carbon, ball bearing arc control feeds the carbons continuously as consumed, accommodates full 8-inch trim without resetting carbon, has widely spaced bearings which assure perfect alignment throughout entire trim.

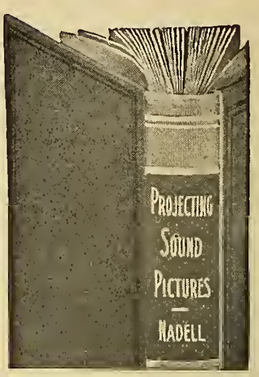
FOR SALE BY INDEPENDENT SUPPLY DEALERS

The Strong Electric Corporation

2501 LAGRANGE ST. TOLEDO, OHIO
Export Office: 44 Whitehall St., New York City, N. Y.

Just Published!

the key to better sound projection



HERE is the clear, simple explanation of sound equipment, its operation and repair, needed by all projectionists. Gives the fundamental principles on which all makes of equipment are based. Explains their use so that you can recognize the nature of any sound trouble, trace it to its cause, diagnose its importance, take the right steps to correct it. Shows when and how repairs can be made in a hurry—when replacement of parts is necessary. Shows how to keep your show running, with sound of the best quality.

Projecting Sound Pictures
By AARON NADELL

Publix Theatres Corporation; Formerly of Electrical Research Products, Inc. 265 pages, 6 x 9, 100 illustrations, $2.50.

Everything in this book is practical and explained in understandable language. Instead of describing all makes of sound equipment in detail, the author clearly outlines the fundamentals of mechanisms and circuits found in all sound apparatus, and which, when understood, make easy the location and cure of all sound troubles.

Covers theory and mechanical requirements of sound-on-film and sound-on-disc
—projectors, amplifiers, rectifiers, loud speakers, motors, generators—their principles, operation, maintainence
—photo-electric cells, vacuum tubes and circuits
—acoustics
—care of sound equipment and precautions to prevent trouble
—tracing trouble

See this book for 10 days FREE
Send this coupon today

McGraw-Hill Book Co., Inc.,
370 Seventh Ave., N. Y. City.

Send me Nadell-Projecting Sound Pictures, postpaid for ten days' free examination. I will send $2.50 or return the book within ten days of receipt.

Name ....

Address ....

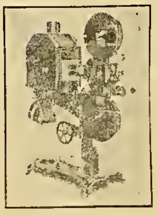
City and State ....

Position ....

Company ....

M.P.-11-31

Sell Portable Talkie Sound-on-Film to Theatres, Schools, Churches, Clubs, etc.



Write for manufacturers' prices on Soundheads, Photocells, Optical Systems, Rectifiers, Amplifiers, Horns, Faders, Synchronous Motors, Projectors, Lamphouses, Screens, Microphones, etc.

S. O. S. Corporation
Dept. M. P., 1600 Broadway,
New York City
Cable Address, "SOSOUND"

The S. M. P. E. Fall Meeting

(*Continued from page* 24)

"May I also pay tribute to those courageous pioneers whom we have honored this evening. Their determination permitted them to conquer physical obstacles and public skepticism. I am reminded of a pertinent episode.

Progress and Piety

"About a century ago a far-sighted New England gentleman applied for leave to debate the possibility of steam railroads in the village schoolhouse. The skeptical Board of Selectmen answered him in the following uncompromising language: 'You are welcome to the use of the school house to debate all proper questions in, but such things as railroads and telegraphs are impossibilities and rank infidelity. There is nothing in the Word of God about them. If God had designed that His intelligent creatures should travel at the frightful speed of fifteen miles an hour by steam He would clearly have foretold it through His holy prophets. It is a device of Satan to lead immortal souls down to hell.' And so it was with motion pictures in the early days. Few had faith and still fewer the ability to carry forward the art. Tonight we have recognized some of those brave and clear-visioned men who battled with the unknown in those trying times.

S. M. P. E. a Standard Bearer

"May I also express my belief that the S. M. P. E. is destined to be the standard bearer and representative organization of the motion picture engineers.

"Through this body, the motion picture industry is rapidly learning of the importance of the engineer. For the first time artists and engineers are working together, as they should, both of them creative in spirit, dignified in their activities, professional in their outlook, and both troubled by similar problems. The staffs of operating technicians in the

INSURE YOUR JOB!
Study F. H. Richardson's
Handbook of Projection

Three volumes containing over 1,400 pages of vital knowledge with question and answer index. Every projectionist needs this authoritative guide. See your local theatre dealer or send for full details.

CHALMERS PUB. CO.
516 Fifth Ave., N. Y.

Try this Remedy for
imperfect Sound and Sight

Ideal sound reproduction and otherwise perfect projection is impossible with an unsuitable Sound Screen. Sound pockets—distortion of both sound and sight—are frequently traceable to the screen.

VISIBESTONE
THE PERFECT FIREPROOF SOUND SCREEN

frees your projection from distortion. Acoustically correct in every detail, it is a reliable solution to one of the most vexing problems of the projectionist. Ask your National Theatre Supply Company branch or apply direct to the manufacturer—

KEASBEY & MATTISON COMPANY
AMBLER, PENNA.

FEATURES
1. Fireproof
2. Free from distortion of sight or sound
3. Acoustically perfected
4. Eliminates "sound pockets"
5. No glare—restful to the eyes
6. Easy to clean—lasts longer

Approved by E.R.P.I.

ask the fellow who uses one!
. . . . he'll tell you

HOFFMANN-SOONS
RHEOSTATS *are perfect!!*

Every PERFECTION RHEOSTAT has satisfied its owner. Breakdowns, service-calls and trouble are unknown to *Perfection* users.

THE ONLY UNION MADE RHEOSTAT

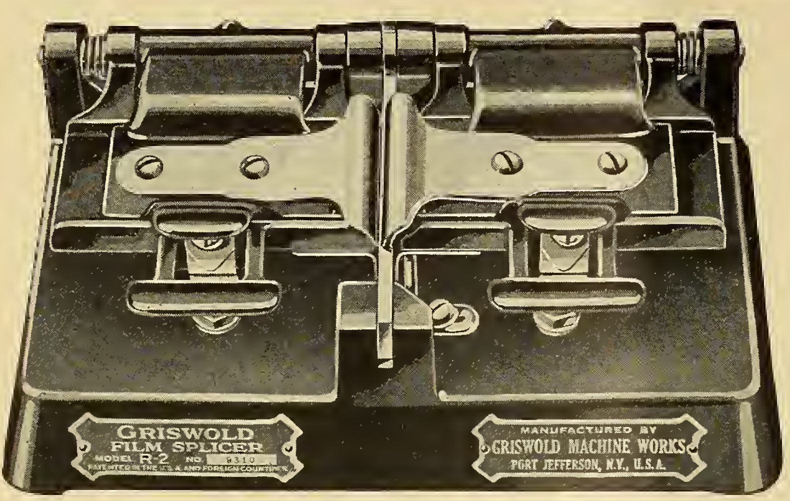
Recognized as the Highest Standard everywhere.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to 4/0 without any additional cost.

We build rheostats for special requirements. Comunicate with us Direct. There is no obligation.

Sold by all Branches of National Theatre Supply Co., Sam Kaplan, New York, Continental Theatre Accessories, and by your dealer.

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 FIRST AVENUE, NEW YORK
Contracting Electrical Engineers—Moving Picture Theatre Electrical Specialists


GRISWOLD
FILM SPLICER
MODEL R-2
PATENTED IN THE U.S.A. AND FOREIGN COUNTRIES
MANUFACTURED BY
GRISWOLD MACHINE WORKS
PORT JEFFERSON, N.Y., U.S.A.

Known and used the World Around

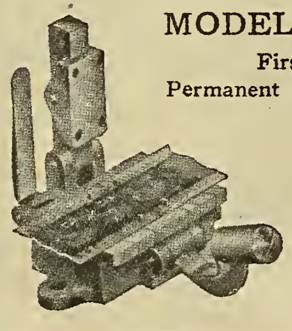
MORE than 15,000 Griswold Film Splicers are in constant daily use throughout the world. For years the perfect splice has been made with a Griswold. Griswold is the standard film splicer for efficiency, durability and economy.

GRISWOLD MACHINE WORKS

Port Jefferson, L. I. New York

Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22



First-Class Results on New or Old Film

Permanent Gauge No Adjusting

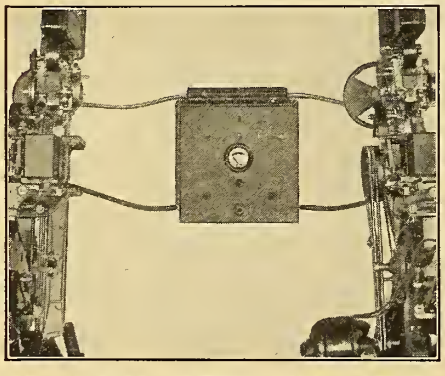
FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.

For sale by all Supply Dealers

MELLAPHONE ALL-ELECTRIC THEATRE AMPLIFIER



MELLAPHONE All-Electric Theatre Amplifier
Two Mellaphone Sound Heads, one Mellaphone All-Electric Theatre Amplifier and Stage Speakers complete Sound Installation.

Eliminates "A" and "B" batteries, charging and amplifying equipment. Complete control of power supply for exciter lamp and photo electric cells. Complete amplification control. Perfect filter, no hum. Tone improved. A compact unit 15½" sq. 13" deep. 110 or 220 volt. 50-60 cycle.

Write or wire for full information

MELLAPHONE CORP.
ROCHESTER, N. Y.

studios and theatres are also coming closer each day to the engineer. Each group can be of greater help to the other. The engineer can explain the reason for the equipment design to the technician, can bring out the fine points of its utilization, and can anticipate and cure the troubles which may arise in its daily use. The technician, on the other hand, can present to the engineer a multitude of practical problems of daily routine which require ingenuity for their engineering solution. He can make most valuable criticisms and suggestions.

"These groups should and must come closer together, and it is to be hoped that the Society of Motion Picture Engineers will contact directly with the technicians of the industry with this aim in view. I shall not touch further on the tasks of the Society in the immediate future, particularly since they have been so clearly outlined to you in President Crabtree's opening address.

Stress Cooperation

"I wish only to emphasize, in more general terms, that we shall all work together in this Society to bring more science into the field of motion pictures and, by this means, greater effectiveness, increased acceptance of the product by the public, and a continually higher status of the motion picture industries. We have this privilege of working for the growth of that agency, science, which was so well described in the inscription on the dome of the building of the National Academy of Sciences in Washington, where it is stated: 'To science, pilot of industry, conqueror of disease, multiplier of the harvest, explorer of the universe, revealer of Nature's law, eternal guide to truth.' Gentlemen, with this aim in view, your officers will endeavor to carry forward the work of their able predecessors during the coming year."

Theory and Fundamentals

(*Continued from page* 29)

the secondary impedance (Z^s) is only 10 ohms. This change in impedance has occurred as can be seen, only through the use of the 4 to 1 ratio transformer.

If, for example, the impedance (Z^s) were a loudspeaker and the generator were a vacuum tube, the 4 to 1 ratio transformer would cause the 10 ohm speaker to represent a 160 ohm load, it can be said to be the equivalent impedance of the 10 ohm speaker load expressed in terms of primary of the transformer.

Knowing the behavior of the transformer as explained above the equivalent impedance can be calculated at any time by the following formula:

$$Z_p = N^2 Z_s$$

where

Z_p = equivalent primary impedance
Z_s = secondary load impedance
N = transformer ratio.

Applying this equation to the above example where $Z_s = 10$ ohms, and $N = 4$, then,

$Z_p = (4)^2 \times 10 = 16 \times 10 = 160$ ohms.

The above equation can be represented in the following form when it is desired to determine the correct transformer ratio for a given power tube and a given speaker of known impedance as shown in Fig. 3:

$$N = \sqrt{\frac{Z_p}{Z_s}}$$

As an example assume a vacuum tube has an impedance of 1500 ohms. From the foregoing discussions it was found that for maximum undistorted power the load impedance should equal twice the tube plate impedance. Therefore, the load impedance of the tube or the equivalent primary impedance (Z_p) of the transformer should be two times 1500 or 3000 ohms. Assume the voice coil impedance of the loudspeaker to be used is 30 ohms. Substituting,

$$N = \sqrt{\frac{Z_p}{Z_s}} = \sqrt{\frac{3000}{30}} = \sqrt{100} = 10$$

The correct ratio of transformer to be selected is 10 to 1.

Principles of the Arc

(*Continued from page* 19)

The active element is composed of a mixture of oxides of iron, titanium and chromium. These ingredients are finely powdered and packed in an iron tube. This mixture produces an arc flame of a very white color which is very efficient for certain illumination purposes.

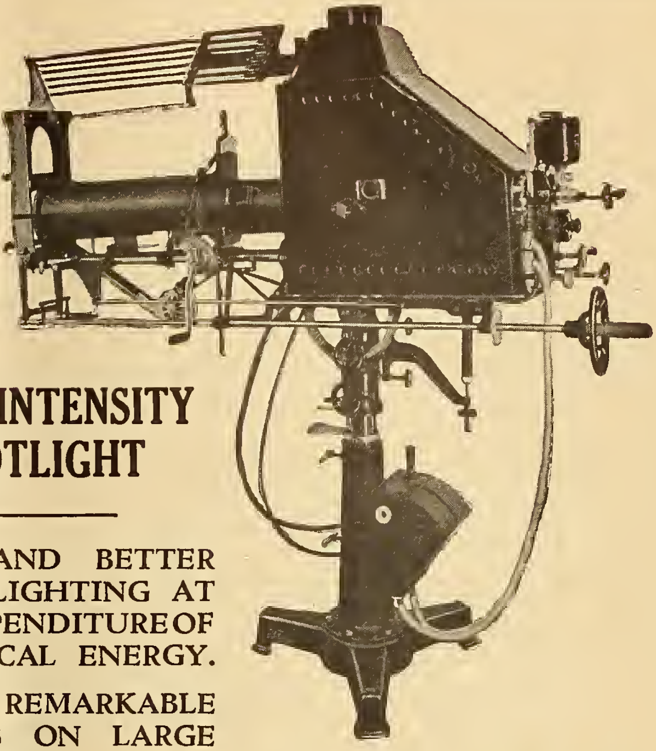
The mercury arc can be produced only in a highly exhausted glass or quartz tube. Its characteristic greenish color is caused by the peculiar spectrum of mercury vapor, which is strongly deficient in red rays.

Because of the great brilliancy of

Learn
TELEVISION

Complete instruction in Television Engineering and Design. Day and evening classes now formed. Write for Booklet "S" if you cannot call in person.
Course under the supervision of Paul A. Kober, A.A., former Television Engineer of General Electric Co.

School of Television
360 Seventh Ave., New York
Corner 30th Street



HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

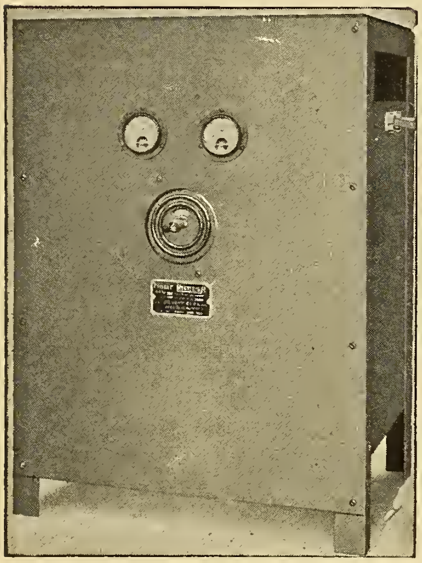
HALL & CONNOLLY, INC.
24 Van Dam St. New York, N. Y.
H&C INC.

SUPER-LITE
SHORT FOCUS
HALF SIZE
LENSES

Increase Illumination
50%
In Comparison With
Quarter Size
Lenses
4" EF. to 8" EF. Sizes

PROJECTION OPTICS CO., Inc.
330 Lyell Avenue
Rochester, N. Y. U. S. A.

Good Projection Requires Good Rectification



M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes then the other two as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

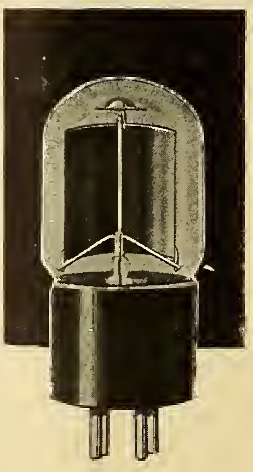
We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP
New and Wilsey Sts.
Newark N. J.

an arc lamp, and also because of the great heat which it generates, it has many uses. First of all it is used for light. It is also used to obtain the high temperature secured in an electric furnace.

The essential elements of an arc lamp are a pair of electrodes, the regulating device required to establish the arc and to feed the electrodes as they are consumed, and the necessary connections to an external circuit. Arc lamps are generally designated by the type of electrodes used, as carbon, flame carbon, metallic oxide, or mercury arcs.

Arcs are also classified as series or parallel types, according to the system of distribution to which they are adapted. Distinction is also made between open arcs and enclosed arcs, depending upon whether the arc is operated with free or with restricted access of air.



PHOTOELECTRIC CELLS
VISITRON
REG. TRADE MARK

Preferred by projectionists who have tried them, because of their better performance—longer life, higher sensitivity and elimination of trouble. . . . Order from any National Theatre Supply Company branch or salesman.

G-M LABORATORIES INC
1733 BELMONT AVE. CHICAGO, ILL.

Index of Advertisers

Bausch & Lomb Optical Co..... 6
Beaded Screen Corp............. 36
Best Devices Co................ 36
Brenkert Lt. Projection Co..... 4
Chalmers Publishing Co......... 39
Eastman Kodak Co............. 7
Fish-Schurman Corp. 7
Forest Electric Corp........... 42
General Machine Co............. 40
G-M Laboratories, Inc.......... 42
Griswold Machine Works....... 40
Hall & Connolly, Inc........... 41
Hoffmann-Soons, Inc. 39
Ilex Optical Co.........Front Cover
International Projector Corp., Back Cover
Kaplan, Sam, Mfg. & Supply Co.. 2
Keasbey & Mattison Co......... 39
McAuley, J. E., Mfg. Co........ 3
McGraw-Hill Book Co.......... 38
Mellaphone Corp. 40
Movie Supply Co............... 38
National Carbon Co............. 5
National Theatre Supply Co..... 43
Projection Optics Co. 41
Roth Bros. & Co............... 8
School of Television............ 41
Service-On-Sound Corp. 38
Strong Electric Corp. 38
Universal Electric Welding Co... 42
Vallen Electrical Co............ 36
Walker Sound Screen.......... 6
Weber Machine Corp........... 36
Weston Electrical Instrument Corp. 4

SOUND REELS
For Perfect Projection
—All Sizes—

ALL-WELDED TYPE
One Unit

LASTING DURABILITY
Bright Cadmium Plated

DEMOUNTABLE TYPE
Each side one unit

ALL PARTS REPLACEABLE
Write for quotations

UNIVERSAL ELECTRIC WELDING COMPANY
9-16 Thirty-seventh Ave., Long Island City, N. Y.

ANYTHING YOU NEED!

To improve projection; to cut down operating expense; to promote safety and efficiency; to make a quick repair ...... anything needed to improve the mechanical service in the projection room or in other department of the theatre is always quickly available at National. And when you get it from National you can always be sure it's a *dependable buy.*

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

REPAIR—REPLACE NEWS

VOL. 1, NO. 1 OCTOBER, 1931

REPLACE WITH SIMPLEX PROJECTORS

Neglect Is Poor Economy

"It is an excellent thing that theatre owners are coming to the greater realization of the importance of good projection. In the past there has been too great a tendency to believe that all expenditures for the proper maintenance of equipment and the betterment of projection were a waste of time and money. Good projection can only be secured by having good men, good working conditions and standard equipment kept in first class condition at all times. Projection rooms are under weekly supervision by inspectors of the Department, but will not compel repairs and replacements unless it is necessary to do so. **Neglect, however, is very poor economy and theatre owners and managers should not wait until they are compelled to make repairs.** Equipment kept in the right condition insures the safety of audiences, adds to their pleasure, reduces damages to film and I sincerely believe increases box office receipts."

BART F. GREENE
Chief Inspector of the Bureau of Gas & Electricity, City of New York

The Effect of Motion Pictures on the Eyes

(Presented before the Society of Motion Picture Engineers.)

Under favorable conditions moving pictures do not cause serious eye fatigue, but it must be borne in mind that several very important elements are necessary to make these "favorable conditions."

If the eyes of the observer are normal for distance vision or corrected for refractive defects the owner should not experience discomfort in viewing motion pictures provided certain other conditions prevail.

Proper projection is an important factor in the elimination of eyestrain and eye discomforts and here again great improvements have been made in the mechanical field.

Any unsteadiness or jerkiness will produce eyestrain as a result of the abnormal burden placed upon the extrinsic muscles of the eye in their effort to keep the eyes in alignment with uncertain and erratic movements of the pictures on the screen.

GUY A. HENRY
General-Director of the Eyesight Conservation Council of America

The Economy of Good Equipment

We wonder how many readers of our department took note of Harold B. Franklin's article in the "Showman," published in the "Motion Picture News" of May 5. I have always been a great admirer of Mr. Franklin's methods, and in looking over his article find many valuable pointers that intelligent managers everywhere ought to take note of.

Let me quote one sentence, in which he says, "It is not necessary for a manager to be able to understand the details of projection, but the successful manager should be able to distinguish good from bad projection, and **the progressive manager keeps abreast with the improvements that are brought forth in the field."**

Which leads us up to the subject of projection. We were very much surprised to find in our travels that this very important item in theatre operation has been sadly neglected in many of the smaller towns. We happened upon a theatre in a town about twenty thousand population, and the theatre appeared to be quite modern and up-to-date, with the exception of the picture on the screen. And when we reached the booth, we found equipment so ancient, as booth equipment is judged today, that it would look far better reposing in a museum. The projectors were of a very old model, the lamps were the old type arc, and the generator was a big affair that belonged in the same museum with the rest of the equipment.

Without treading on the manager's toes (and he, by the way, was one of the owners of the theatre), we tried to show him what a mistake he was making, both from the standpoint of good projection and economy in operation.

At this time it is not our intention to take upon ourselves the recommendation of any particular type of equipment for the booth as we are selling nothing but ideas, but we do know that **new equipment would have paid for itself in this theatre in just about a year, not taking into consideration the marvelous improvement in the projection.**

Managers Round Table Club
CHARLES E. LEWIS

REPAIR WITH GENUINE SIMPLEX PARTS

Poor Projection Means Poor Business

Poor screen results will do more to injure a theatre's reputation and patronage than any other single factor. Bad projection and good business are never companions. Show me a theatre where proper projection standards are not maintained, and I shall show you a theatre where business is in the same category as its projection. **Good projection requires good projectors.**

WILLIAM F. CANAVAN
International President, I.A.T.S.E. & M.P.M.O.

Fire Prevention

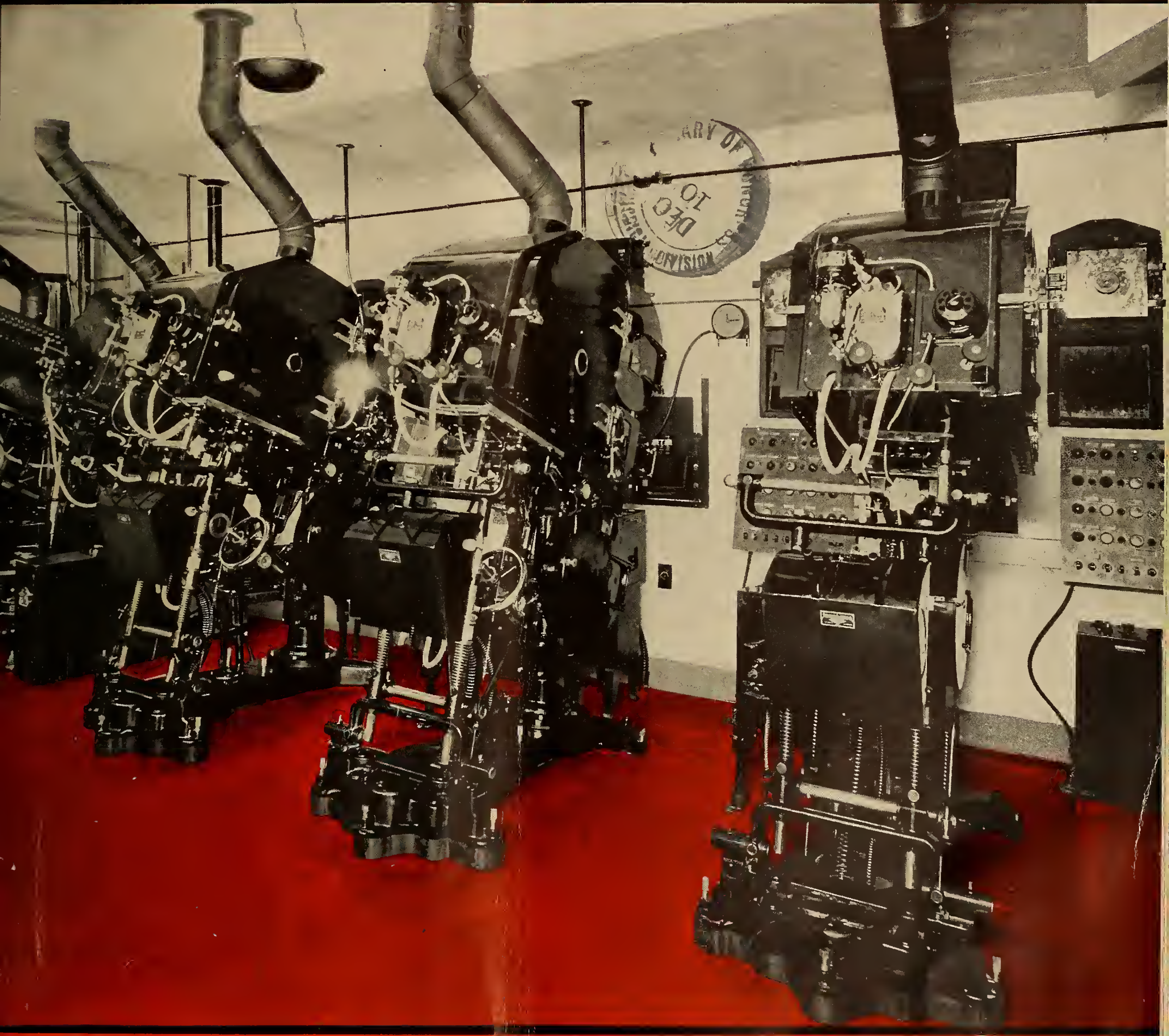
In the afternoon session, after reports of officers, Fire Marshal of Canada, Grove Smith, gave a fine address which was warmly applauded. He pointed out the excellent record of fire prevention in Canada and stated that a majority of the modern theatres were fireproof. **He likewise advised that no old projection machines should be used.**

"Exhibitors Daily Review," Thursday, Oct. 18, 1928

Simplex
The International Projector

INTERNATIONAL PROJECTOR CORPORATION
90 GOLD STREET - - NEW YORK

MOTION PICTURE PROJECTIONIST



Published by the MANCALL PUBLISHING CO., Boone Mancall, *President.*
Editorial and Advertising Offices, 7 West 41th Street, New York City.
Entered at New York Post Office as second class matter, October 25, 1927.

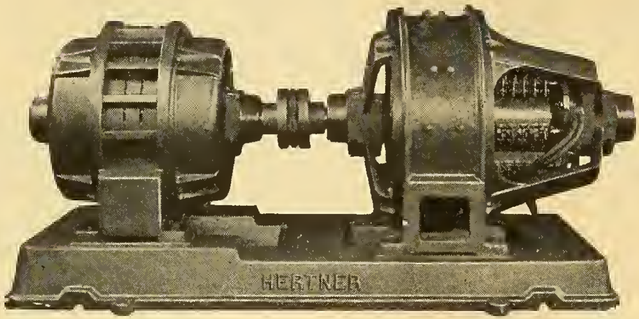
Vol. 5 • No. 2
25c per copy $2 per year

December, 1931

FIFTH YEAR OF PUBLICATION

ECCENTRICITIES

Are Expected from an Artist



TYPE CP TRANSVERTER

Side Lights on the TransVerter

* * *

A TREE

bears fruit in proportion to its freedom from parasites that drain its strength.

A THEATRE

shows dividends in proportion to the performance of its projection room. Keep the "bugs" out of it by supplying it with uniform current from a

TransVerter

But a mechanically perfect machine must have no Temperament.

Such is the Transverter . . . never faltering . . . ever reliable . . . day in and day out giving smooth constant voltage . . . ensuring uniform projection.

The Transverter is the result of many years of specialization in motor generators designed expressly for the Motion Picture field.

It does a better job because its engineers know the conditions it must meet and have built into it the factors which enable it to give even greater performance than one expects.

Whether your theatre is "the movie around the corner" or the most de luxe house in the city . . . Hertner has a Transverter expressly for your needs.

Manufactured Exclusively by

THE HERTNER ELECTRIC COMPANY

12688 ELMWOOD AVENUE TransVerteR CLEVELAND, OHIO, U. S. A.

MOTION PICTURE PROJECTIONIST

December, 1931 Vol. 5, No. 2

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* P. T. Sheridan, *Sound Projection;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Mortimer Glancoff

Editorial & Advertising Office
7 West 44th St.
New York City.

273

V. T. Huge Welding Project in Miniature

That the production of a vacuum tube parallels a tremendous industrial task, in miniature, was pointed out by George Lewis of the Arcturus Radio Tube Company, Newark, N. J., at a recent meeting of industrial engineers.

Aside from the numerous fine elements used in the construction of a tube which could be termed analogous to minute girders, braces, crossmembers, etc., there are 186 various spot welds in the final assembly of the elements.

This is equivalent to the number of welds required in laying a ¾-mile pipe line, with each section of pipe 20 feet long. This would be sufficient to weld all steam and water pipe connections in the average home; or, in the marine field, to weld a mammoth anchor chain 93 feet long for one of the big ocean liners. In aviation, a complete plane including the frame and fuselage could be securely welded with this large number of operations.

NOW YOU'VE GOT SOMETHING BETTER TO SELL

THE best way to boost business is to offer greater value. In movies it's greater *pleasure.* Now you can give your patrons just that. *You've got something better to sell.* Eastman *Super-sensitive,* the most widely used negative film in the industry, results in better-directed, better-acted, better-photographed, better-finished pictures. And, whether your patrons are entirely aware of all these improvements or not, the fuller satisfaction they get will automatically show in your box-office receipts.

EASTMAN KODAK COMPANY

J. E. Brulatour, Inc., Distributors
New York Chicago Hollywood

F. S. C.
Optical Crown Plates
For enclosing Portholes of Projection Booths
PRECISION SURFACES
NO DISTORTION

S. O. G.
"IGNAL" CONDENSERS
Made of extra heat resisting Optical Glass
ALL SIZES
ALL FOCAL LENGTHS

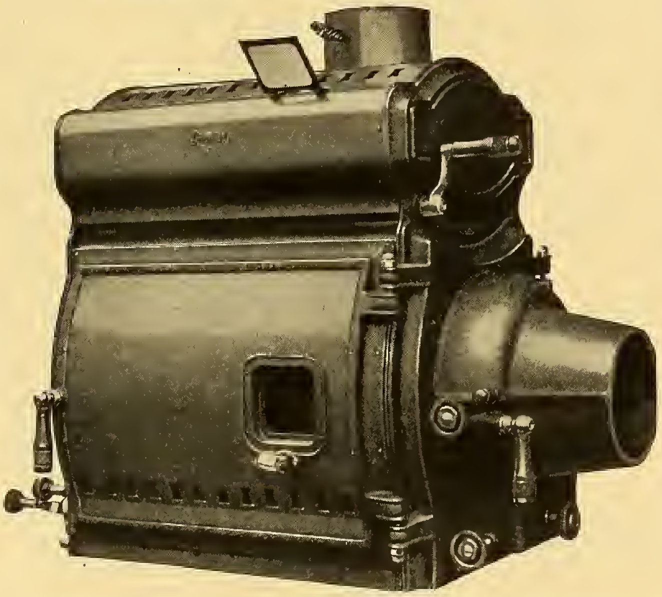
Sole Distributors
FISH-SCHURMAN CORP.
45 West 45th Street New York City, N. Y.

PERFECT SCREEN RESULTS
LOW MAINTENANCE
COST • RELIABILITY
Are BUILT-IN Characteristics of the

Brenkert

SUPER HIGH INTENSITY
PROJECTION LAMPS

Giving
Complete
Satisfaction
From COAST to COAST



Distributed by Independent Theatre Supply Dealers

Ask Any User

A Brenkert PRODUCT

Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

Highlights on Radio City

THE creation of Radio City, the largest single amusement project ever attempted, represents the crystallization of an idea conceived by Mr. John D. Rockefeller, Jr., early in the year 1930 for the construction of a metropolis to be devoted to the development of the educational and entertainment advantages of radio and of the new electrical arts of sound and vision. Mr. Rockefeller having enlisted the support of Messrs. John R. Todd, Owen D. Young, David Sarnoff, Merlin Aylesworth and Hiram S. Brown, the necessary steps were taken to launch the enterprise. The Metropolitan Square Corporation, with Mr. Arthur Woods as president, was formed for the sponsoring and financing of the building project and to take title to the properties. The services of the firms of Todd, Robertson, Todd Engineering Corporation and Todd and Brown, Inc., were secured as builders and managers. The total supervision of the construction rests with these organizations. For the design and planning of the great edifices, Reinhard & Hoffmeister; Corbett, Harrison and MacMurray; and Hood & Fouilhoux, three prominent firms of architects, were chosen.

Located in the heart of Manhattan, the massive and towering structures which are to comprise Radio City will occupy more than ninety per cent of the three blocks between Fifth and Sixth Avenues, from 48th Street to 51st Street. A new street will be laid through the development in a north and south direction, about 300 feet west of Fifth Avenue.

A part of the center block is to be devoted to a large sunken plaza covering almost an acre of ground. This plaza will contain a central thirty-foot fountain, set off by smaller fountains, statuary and shrubbery. The new street will encircle the plaza. Directly west of the plaza will rise the central structure in the group, an office building of seventy stories, containing a greater floor area than any other office building in the world. This unit is to be provided with a sixteen-story wing fronting on Sixth Avenue. Two six-story office and shop buildings, fronting on Fifth Avenue, are to occupy the eastern portion of the center block. Between them, a wide promenade will be provided, affording an impressive view across the plaza to the imposing central tower beyond.

Construction work is already under way on the International Music Hall, which is to occupy the west half of the block between 50th and 51st Street. This structure will house the largest theatre in the world with a seating capacity of 6,100 persons. This great building will adjoin a thirty-one-story office structure which is to be located on Sixth Avenue at the northwest corner of the development. An office or club building is planned for the area between the International Music Hall and the transverse street to the east. The size of this building remains yet to be determined.

Eastward, on the other side of the new private street, will tower another large skyscraper comprising forty-five stories. The northeast corner of the property will be occupied by yet another great structure. Its tenancy has not as yet been decided.

On the south block there will be erected east of the transverse street a forty-five-story building to balance its companion on the north block. The sound motion picture theatre, having an auditorium seating 3,500 persons, is to be erected at the Sixth Avenue end of the block. A large area extending from this theatre eastward to the new street is being reserved pending negotiations with the Metropolitan Opera Company for the erection of a new opera house.

From the roof of the sixteen-story structure on Sixth Avenue there will be a forty-foot drop of water, which will then cascade to end in a spacious reflecting pool.

PRESTIGE!

THE SIGN ABOVE THE BOX OFFICE THAT BRINGS PATRONS TO THE THEATRE!

QUALITY sound reproduction is the theatre's most important asset . . . The best recorded pictures are doomed to dismal failure if the sound reproduction is not efficient . . . Today more than ever before, the public is demanding "sound satisfaction". . . Every wise exhibitor is conscious of these facts . . . That is why so many are installing RCA Photophone equipment.

RCA Photophone Standard Size apparatus for theatres up to 1,200 seats and Special Size apparatus for theatres up to 500 seats, both AC operated, are conceded to be superior to any other types of equipment in their respective fields.

STANDARD SIZE EQUIPMENT	SPECIAL SIZE EQUIPMENT
\$2500.00	**\$1600.00**
Cash or terms	*Cash or terms*

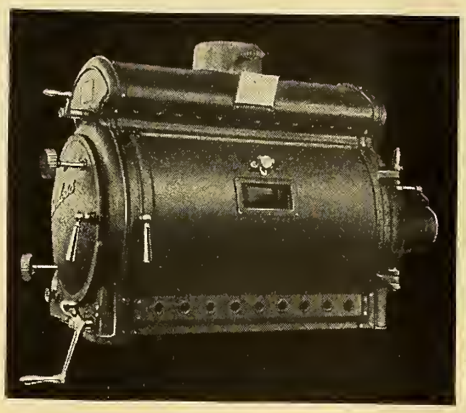
F. O. B. Brooklyn Warehouse

Servicing of equipment following installation an assurance of complete sound satisfaction

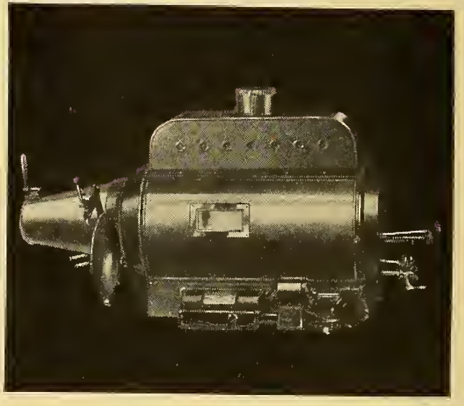
RCA PHOTOPHONE, INC.
(A Radio Corporation of America Subsidiary)
411 FIFTH AVENUE NEW YORK CITY
Branches in Principal Cities

Peerless

"The Super Reflector Arc Lamp"



HIGH INTENSITY REFLECTOR ARC



LOW AMPERAGE REFLECTOR ARC

99 TIMES IN EVERY 100

Peerless Reflector Arc Lamps are the "Preferred Choice."

To be universally acknowledged the "one" indispensable requisite for perfect projection, requires more than the indiscriminate use of printer's ink. Such a position can only be attained by a product that is correct in principle, advanced in mechanical execution and which has proven itself superior in actual service and performance.

The light producing reserve of Peerless Reflector Arc Lamps brings all projection requirements easily within their ability to do the job best, with greater economy, reduced up-keep cost and hence, greater purchaser's satisfaction.

"First Choice" and "Peerless" are inseparably associated.

WHY EXPERIMENT?

MANUFACTURED BY

J. E. McAULEY MANUFACTURING COMPANY

552-554 West Adams St., Chicago, Ill., U. S. A.

DISTRIBUTED BY NATIONAL THEATRE SUPPLY COMPANY BRANCHES EVERYWHERE

National SRA Carbons

•

IN many theatres using low intensity Reflecting Arc projectors, National SRA Carbons are satisfying the demands for a higher level of screen illumination brought about by the introduction of sound, color and larger screen image.

National SRA Carbons permit substantial increase in arc current and provide an intense crater brilliancy. This powerful crater light is focused on the aperture plate in a field of even intensity. Liberal latitude in positive crater position assures uniform illumination of screen.

The greatest volume of light available from the low intensity mirror arc projector is obtained by the use of National SRA Carbons. This is satisfying to both theatre manager and projectionist. The steady brilliant screen illumination they provide is equally pleasing to the patron. And—

—two satisfied patrons pay for the carbons used at each performance.

•

NATIONAL PROJECTOR CARBONS

. . . Sold exclusively through distributors and dealers. National Carbon Company will gladly cooperate with the producer, exhibitor, machine manufacturer or projectionist on any problem involving light.

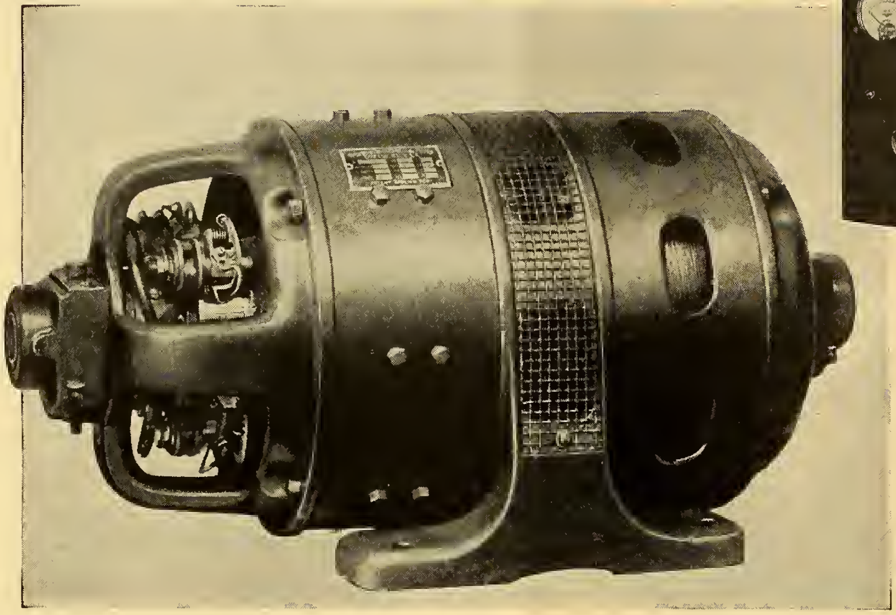
NATIONAL CARBON COMPANY, INC.
Carbon Sales Division ' Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York Pittsburgh Chicago San Francisco

•

THEY KEEP A-RUNNING

ROTH ACTODECTORS

ROTH
ACTODECTOR
CONTROL
PANEL



20/40 to 100/200 Ampere 2-Bearing Actodector

CONTINUOUS OPERATION

Century-Roth Inverted Rotary Converters

deliver alternating current, from any direct current source, for operating Gaseous Tube Signs, Public Address Systems, etc.

Based on a complete knowledge of the particular requirements in projection booths, Roth Multiple Arc Type Actodectors are accurately built and liberally proportioned to insure continuous operation . . . They are especially suited to sound equipment installations . . . They supply steady direct current power to the arcs, which results in brilliant screen illumination of uniform intensity—even during change-over . . . Size range—20 to 600 amperes . . . Furnished in 2- and 4-bearing types, dynamically balanced.

ROTH BROTHERS AND CO.
Division of Century Electric Company
1400 W. Adams St. Chicago, Ill.
Distributors and Offices in all Principal Cities

ACDC-13

DIRECT CURRENT
MOTORS AND
GENERATORS

ROTH

MOTOR GENERATOR SETS AND ROTARY CONVERTERS

As The EDITOR *Sees* IT

¶ *Fair Rewards*

ONE of the more recent editorials published in this magazine emphasizes the importance of closer cooperation among the various technical branches of the motion picture industry.

For a striking example of the value of such coordinated effort and mutual understanding, the attention of our readers is directed to the timely proposal of the Academy of Motion Picture Arts and Sciences for the standardization of motion picture apertures. Complete details of the plan as prepared by the Academy appear on another page of this issue.

Simple in its conception, involving merely the establishment of a definite and universally accepted dimensional standard for the picture aperture, the scheme, which is deservedly meeting with general approbation, will be far-reaching in its application. Its advantages are many and inevitable. Its possible disadvantages, which are listed with engaging frankness in the report, are trivial and inconsequential.

One's first impression gained upon reading the proposal is the enormous saving which its adoption will represent in time, labor and money. We quote from the report:

In the Studio: "Scaffold lights can be lowered from three to five feet, thus making possible a reduction in the wattage and the number of units.

"The tops of large sets can be lowered by as much as six feet and all sets can be reduced without making any change in the placing of essential action and props as photographed for the past year.

"A single aperture will make for better composition on the set for both the cinematographer and the director.

"The studios will be assured that the picture will be projected as it was photographed. Projectionists have had wide leeway in framing and no guide to show them when their proportional aperture was centered until they saw heads and feet cut off on the screen.

"Microphones can be lowered from three to five feet, resulting in an obvious advantage in sound quality and convenience for the sound department.

"Camera lenses can be recentered on the new aperture for better optical coverage."

And in the Theatre: "All pictures can be projected through a single standard aperture, doing away with movable flippers and changes of screen masks, aperture plates and lenses during the show.

"The frame lines just outside of the aperture, as they used to be for silent pictures, will be a help to the projectionists in keeping in correct frame. If the picture should momentarily go a little out of frame the projectionist will be warned by seeing a frame line, but as the lines are wide the misframe can be corrected before the audience notices it.

"Standardization of exact dimensions by the studios will give the projectionist more uniform prints from the various companies.

"Theatres now using reduced proportional apertures will gain four per cent more screen image without additional magnification.

"Theatres now using the movietone aperture or the old silent aperture will gain the advantage that the studios can fill the whole area of the new standard aperture with essential drama action and will not have to leave a border of unimportant picture."

The validity of these claims is amply established in text of the proposal. The cost of the change, insofar as the average theatre is concerned, entails merely the purchase of new aperture plates at an estimated total cost of three dollars—a small sum indeed, in view of the enormous advantages to be derived by so many and varied departments through its acceptance.

That the new aperture specifications will be adopted, there is not the vestige of a doubt. Many of the leading studios and several of the foremost theatre circuits have already signified their approval. Possible objection to the proposed change rests principally in the fact that a large part of foreign release is now on full frame disc and exhibitors are accustomed to showing the American product in this way. However, as is pointed out in proposal, economic considerations will doubtless induce the foreign producers to accept the American standard, and foreign theatres now showing full frame can make the same adjustments as those recommended for the American houses.

It is also noted that there will be a period when prints with different apertures are circulating side by side, but as the committee's report justly observes, the advantages of the new aperture dimensions far outweigh any temporary inconvenience.

Considered in all its aspects the proposal reflects greatly to the credit of its originators. The Academy of Motion Picture Arts and Sciences is deserving of high praise for the distinguished service which it has rendered to the industry.

CHARLES E. BROWNELL.

The How and Why of Lenses

By LLOYD E. HARDING

In the following article, the author explains in non-technical language certain of the principles underlying the science of optics. The subject is treated in a novel and progressive manner calculated to show in a simple way the various functions of lenses.—THE EDITOR.

IT will be profitable for the projectionist, who naturally has a great deal to do with lenses, to know something about light rays and their actions upon striking and passing through various transparent materials. Usually he is told, or he reads, that a lens "focusses" the light at a certain point, or that the light rays are refracted to a certain degree by flint glass and to a different degree by crown glass, without understanding why light is affected by these different materials, so that a lens of one material produces a greater focal length than a lens of different material of the same size and shape.

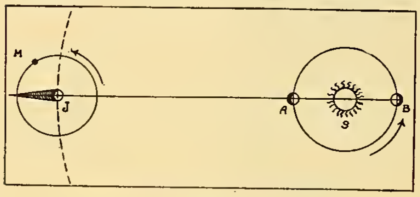


Fig. 1

In explanation of this action of various transparent materials upon light rays, it may be said that it is due to the fact that the speed of the light ray is changed when it strikes any material, and that the harder or denser the material the more the ray is retarded and the lighter the material the more the speed of the light ray is increased.

The Velocity of Light

That light has a definite speed of travel is well known. Its measurement has been made by a number of scientists. One of the earliest was made by a man named Roemer in the year 1675. The results of all the various methods used check so closely that there is no possibility of error, the speed of light being determined as about 186,000 miles per second.

Roemer's method of ascertaining the velocity or speed of light is interesting. Referring to Figure 1, you see a diagram representing the Sun, S, with the Earth revolving around it as designated by the circle, the Earth being shown at two different places in its path around the Sun, at A and at B. This path of the Earth around the Sun is called the Earth's orbit.

To the left is seen the planet Jupiter, J., which also revolves about the Sun but at a greater distance from it. Around Jupiter travel four moons, only one of which is shown at M. The shaded cone seen at the left of Jupiter is the shadow thrown by Jupiter as it stops the light from the Sun. Now as the moon, M, revolves about Jupiter, J, it is visible from the Earth at all times except when it plunges into the shadow of Jupiter, when it can no longer be seen from the Earth. This is known as an eclipse of Jupiter's moon, M. These eclipses occur at fairly rapid and regular intervals so that the occurrence of each eclipse can be accurately predicted in advance.

After many observations it was found that the eclipse of the moon, M, occurred 16½ minutes earlier when viewed from the Earth in its nearest position at A than when viewed from its farthest position at B. The only conclusion it was possible to reach was that the 16½ minutes difference represented the time it took light to travel across the Earth's orbit from A to B. As this distance was known to be 185,000,000 miles, it was divided by 990 (which is 16½ minutes times 60 seconds) and this gave the answer desired, approximately 186,000 miles per second. So much for the proof that light has a definite velocity.

Refraction of Light

You are told that when light strikes a lens it is refracted or bent. In the case of a convex lens, which is the type used in the lamphouse as a condenser, the rays are bent inward toward the center of the lens so that the rays gathered by the whole surface of the lens facing the arc are brought to a "spot" at the aperture. What happens to the rays to change their course so that they can be focussed to a single spot?

Let us first take the case of light rays striking a body of water and see what happens to them. Water is a dense material and has a similar effect on light rays to that of glass. In other words, if the body of water shown in Figure 2-A were glass its effect on the light would be similar though more pronounced.

A Practical Example

In Figure 2-A let the light parallel lines represent a body of water, the surface of which is denoted by A B. Assume point C to represent the source of light and C D a ray of light. If the ray proceeding from C is perpendicular to the surface A B, upon striking A B at O it will continue on through the water from O to D in the same straight line without any change in its direction having taken place. C O is called the Normal because it is perpendicular to the surface A B.

Assume now that we move the source of the ray from C to any other position, for example, to point E Figure 2-B, so that in striking the surface A B it forms an angle with the normal C O. The ray E O, upon arriving at O, the point where the two mediums join, will not continue through the denser medium in the same straight line to F, but will be *refracted* (bent) as shown by the line O H.

Angles of Incidence and of Refraction

The path of the ray will now be EOH; the part E O is called the incident ray and O H the refracted ray. The angle E O C is called the angle of incidence, while angle H O D is called the angle of refraction.

When light passes from a rare medium to a dense medium the angle of refraction is smaller than the angle of incidence. Conversely, if the ray H O passing through water meets the surface of air at point O it will not continue in a straight line to J, but will be refracted (bent) away from the normal C D and take the path O E.

Suppose glass was employed in place of the water in Figures 2-A and 2-B, then the refracted ray H O would be closer to D, and if the ray passed out of the glass into air it would be refracted further away from the normal than if it had passed out of the water.

Propagation of Light

Up to this point light has been spoken of as light rays. To explain why these rays are bent when passing from a rarer to a denser optical medium it will be necessary to digress and give a more complete explanation of the theory concerning the propagation of light upon the fundamental property of wave motion. A spherical wave is considered to remain spherical throughout its path of

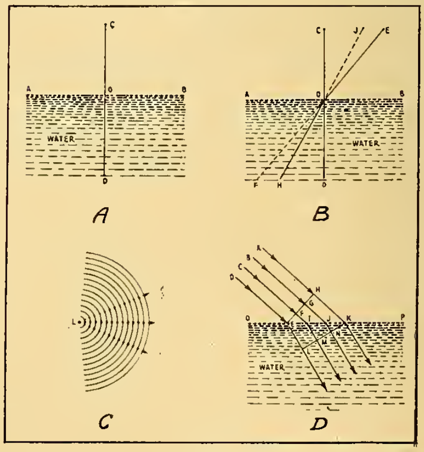


Fig. 2

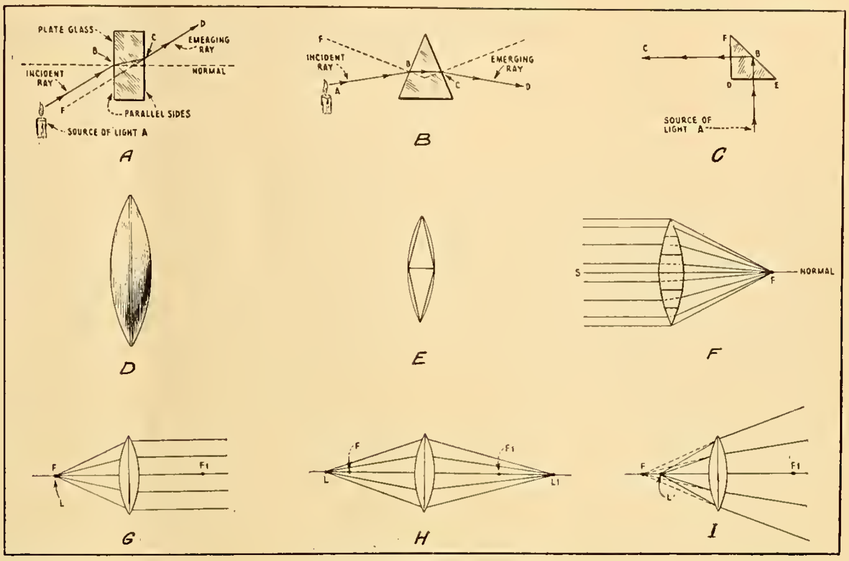


Fig. 3

travel. This form of wave motion is conveniently shown as a number of equidistant concentric circles spreading out from a point of light in ever-widening circles as shown in Figure 2-C.

The single ray idea is derived from the theory that while the wave front has a certain curvature, each little particle of its surface is being continuously projected in straight lines along a radius of the sphere. The light wave then really exists and what we term "rays" are simply straight lines which show the direction in which the wave is traveling. The rays are always perpendicular to the front of the advancing wave and, in the instance of spherical waves, it is along a radius drawn from the point L, as previously stated.

If we consider L to be a mere point the rays diverging therefrom would be termed a "pencil of rays"; on the other hand, if the point L is, for example, the sun, or any other distant luminous object far removed from the point of observation, the waves are for all intent and purpose without any appreciable curvature when they arrive at the point where they are to be a subject of study. In other words, they are considered to be parallel lines of light.

Optical Density

With this in mind let us consider Figure 2-D in which is again shown a body of water. Approaching this is a number of parallel lines called a beam of light. Since the water is of greater optical density than the air, the beam will have its velocity decreased upon entering the denser medium; conversely, if the light beam passes from a dense medium to a rarer medium its velocity will increase. Therefore, we will assume that the light beam E F G H is moving in the direction as indicated by the arrows, and as the light ray D E passes the surface O P its velocity will be less because it has entered a denser medium.

Assuming the denser medium to be uniform, rays C F, B G and A H will all go through the same change in velocity as they pass the surface O P. When ray A H passes the surface the ray D E will have traveled through the water only from E to L, therefore the new wave front will now be L M N K, and since the direction of light is always perpendicular to the wave front the direction now taken by the beam will be that shown by the arrows in the water.

Lenses and Light

We are now ready to study lenses and the behavior of light when passed through them. Lens is the name given to a solid of glass, a transparent medium which, due to the curvature of its surfaces, is capable of diverging or converging rays of light that pass through it. So far we have only traced the light from one medium into another; now we shall follow it from its source, to the medium, through and beyond it.

For our first example a sheet of plate glass will be used through which we shall consider a ray of light to be passing. The ray from source A, Figure 3-A, on entering a sheet of plate glass at B, the faces of which are parallel, will be refracted toward the normal. After passing through the glass, and upon emerging into the air again at C, it will be refracted away from the normal by the same angular amount. The direction of the emerging ray C D will be parallel with the incident ray A B, as shown by the dotted line F C. This explains the reason why an object viewed through a sheet of plate glass appears somewhat displaced as to position but otherwise unchanged in form.

Effects of a Prism

Light passing through an ordinary window pane is refracted in a similar manner, but due to the thinness of the substance the change in position of the object viewed is too minute to be noticed. Now refer to Figure 3-B, a triangular glass prism, and again taking A as a source of light, the incident ray A B, on entering the prism at B, will be bent toward the normal and becomes the incident ray on the surface at C. On emerging into air it is refracted away from the normal in the direction C D. From this we find that a ray of light in passing through a prism as shown is always refracted toward the base of the prism.

Further, if the line of vision coincides with the line C D, the candle will not be seen at A but will appear to the observer to be at F. Therefore, an object viewed through a triangular prism always appears deflected toward the top of the prism.

Figure 3-C represents a right-angled prism which may be classed as a total reflection prism. The ray from source A entering the prism perpendicular to the side D E will pass through the prism without a change of direction until it strikes the face E F at an angle of 45 degrees, when it will be totally reflected and pass out of the prism normal to the surface D F. A prism of this shape, having polished surfaces, makes the best-known reflector.

The Double Convex Lens

Another type of lens we are interested in because of its use in motion picture projection is called the "double convex lens," shown in perspective Figure 3-D. As a boy, how many times have you used this type of glass to burn holes in leaves, paper, and so on, by focusing the sun's rays?

If we place two prisms with their bases in contact and then fill the portion shown by the curved lines with glass, Figure 3-E, it is seen that a double convex lens is nothing more than a curved form of two prisms so placed. This can be brought out more clearly, perhaps, by a study of Figure 3-F, and noting the change in the light rays as they pass through what can be called an assembly of prisms with curved faces in contact.

Keeping in mind what you learned concerning the behavior of light as it passed through the single prism as shown in Figure 3-B, we can see in Figure 3-F that parallel light rays originating, for example, from the sun, S, will, when they strike the upper half of the lens, be bent downward, while the lower half of the lens, acting as an equal number of inverted prisms, will refract the light upward. The light emerging from both the upper and lower sides of the normal converge at the principal focus F.

Since we now understand the evolution of a double convex type lens we can study Figures 3-G, 3-H and 3-I, from which we shall learn the principal effects of lenses on light rays incident on their surfaces.

(*Continued on page* 33)

Painting the Silver Sheet

By JOHN L. CASS

Part I: The Fundamentals of Color

Color has been referred to by Mr. John I. Crabtree, retired president of the S.M.P.E. as the only immediately available variant from the prevailing black and white picture, and its further development is anticipated by leaders of the Industry as the next outstanding technical achievement. The following article from the pen of Mr. John L. Cass, assistant chief engineer of RCA Photophone, marks the first of a series to be contributed by the author on this important subject. Mr. Cass is particularly qualified to discuss the application of color in motion picture science, his engineering experience having embraced many years of research in the color picture field.—THE EDITOR.

THE reproduction of motion pictures in natural color has fired the imaginations of technicians and inventors ever since the beginnings of the motion picture itself. Prior to that time, a tremendous amount of experimentation and research had been done toward obtaining still photographs with the original hues. Considerable success rewarded the early experimenters, but only as a result of intense scientific endeavor and great expenditure of time.

Early Attempts Unsuccessful

With the birth of the motion picture, the attention of experimenters in color was immediately turned to the new field. It was found that very little of the still picture technic was applicable to motion pictures. First, the enlargement necessary in projecting motion pictures made the problem of definition acute. Secondly, making a rapid sequence of photographs of a moving object multiplied the camera difficulties to the nth power. Thirdly, the limitations of the film itself, as to mechanical properties, were entirely different from the usual glass plates in still work.

The early attempts to apply color to motion pictures met with considerable public approval when the choice of subject matter was fortunate, but met with no commercial success because of the limitation in subjects. The motion picture without color progressed rapidly, because it offered an ideal medium for narrative and for dramatic action. Movement could be depicted, and became the basis of success. Color was at its worst in scenes having movement, and so it is obvious why the early methods were doomed to commercial failure.

However, as in many other arts, the early failures formed the basis of further work, the defects were recognized, and the never-tiring experimenters continued to labor, in most cases with little reward. This work continues in the present day, and will doubtless be carried on until every defect has been overcome, which will be, in truth, the millennium.

Two Phases Involved

The problem of applying color to motion pictures naturally divides into two interrelated problems, photography and reproduction. In general it may be stated that the two phases may be considered separately, and that any color system must contain both elements. The quality of the final result on the screen can be no better than the poorer of the two elements used in any particular system. In this respect the color field parallels the sound field, and with similar commercial forces tending toward standardization and interchangeability in the final product.

In these articles, an attempt will be made to outline the various methods of photographing and producing prints, together with the various requirements and factors which affect the commercial situation in the film industry as organized at present. It should be borne in mind that there are as many opinions as there are methods, and that this delineation must necessarily represent one viewpoint, that of the writer.

Alterations Undesirable

The general viewpoint taken here is that the color system should not interfere with established standards and technic to any further degree than is absolutely necessary, with due regard for the accuracy of color rendition on the theatre screen. In the past, there has been a number of color processes developed to the point where actual sales campaigns have been launched. Without exception, those which involved serious alterations of existing equipment, particularly in the theatre, have met with no commercial favor. It is reasonably safe to assume that no process will be looked upon with favor which demands troublesome and expensive changes, unless the perfection of results is such as to guarantee that such changes would react favorably upon the life-giving box office receipts.

Camera and Projector Considerations

From the photographic standpoint, the camera used, if of a special type, should be such as to operate with a minimum increase in the cost of production. The color camera should also be as flexible in handling as an ordinary black and white camera, so that the director will not be hampered in story treatment. The amount of deviation in the actual camera mechanism is of little moment, as also is the case in the subsequent treatment of the color negatives, the method of printing and the processing of prints.

It is extremely important that the final print be such that it will run in a standard projector, at standard speed, and preferably with no change in equipment in the booth or on the stage. It is, of course, obvious that

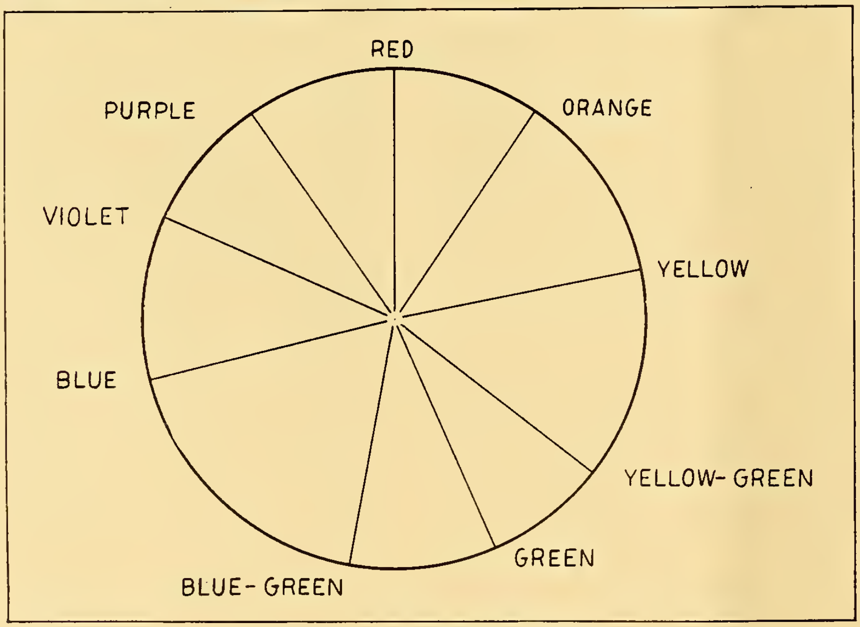


Fig. 1. The Color Circle

a color print must have proper treatment as to type of arc lamp and its adjustment, good quality projection lenses, a clean white screen, and other details which already obtain in a decently run theatre.

Special Attachments Undesirable

It is extremely undesirable to require any special filters, lenses, shutters, or other special equipment on the projector, since means must be provided for furnishing the special attachment to every theatre, and for instructing every projectionist in its attachment, adjustment, and operation. There is the further disadvantage that, where special attachments are used, the color film may not be intercut or spliced together with ordinary black and white film, and even if it is handled on separate reels, there is an added duty for the projectionist to sandwich in with threading, trimming, rewinding, and changeover.

Proponents of certain processes involving such special projecting apparatus have countered arguments of this type with the assertion that the results obtained would be of such perfection that all film would be made in color by this process, and the projectors, once altered would be left that way. Even the most partisan of inventors must admit that there would have to be a long transition period, and it is extremely doubtful that any color process will attain a degree of perfection to which other methods will not attain or surpass, as has been so well exemplified in the parallel developments in methods of sound recording and reproduction.

Laboratory Methods

The desirability of standard operation in studio and theatre is apparent. On the other hand, it matters very little whether or not standard equipment and methods may be used in developing the color negatives or in the positive operations leading up to the print. The necessity for close and specialized control in handling color film makes it almost imperative that these operations be performed in a special laboratory by specially trained technicians.

Existing laboratories for black and white film have not been highly successful in handling color. If the plant and personnel of the laboratory must be separate, the added expense of special machinery is not of paramount importance. This is indeed fortunate, since all color processes in commercial use today require special printing and wet processing machinery, each process having its own type of equipment. The methods in use differ so radically that standardization of equipment would be impossible.

However, all of this special machinery, for accomplishing the intermediate operations, is safely in the laboratories of the several color companies, and so does not constitute a complication for the film industry. These same processes produce prints which are handled in the standard manner, and so may be intercut or spliced with each other or with black and white film. This situation leaves the producer free to use whichever process appears most suitable for the particular subject matter.

In the subsequent discussion of various color methods, first consideration will be given to the application to standard 35 mm. film, followed at a later date with a general discussion of the 16 mm. field and the ease of adaptation of the various methods. Inasmuch as three color motion picture film has not been marketed in the professional field, that will also be treated separately as to probable future.

The Color Spectrum

It will be assumed that the reader has a general conception of what constitutes the visible spectrum, starting with red, and on through orange, yellow, green, blue, violet, and the hybrid purple. The last named is not actually in the spectrum as produced by analysis of sunlight, but is found in nature, and is a mixture of red and blue-violet light. It should be remembered that we are working in terms of colored light, rather than in pigments, the results of mixing colors being entirely different under the two conditions.

For the sake of simplicity, the spectrum will be considered as a circle of color, as shown in Fig. 1. This representation is not in agreement with the wave theory of light, but is of value in visualizing the effect of mixing colors, and has the further advantage of including the purples between the red and the violet. Since this article is intended as a practical approach to color, the circle diagram will be used as a reference.

No Direct Method Available

There has not been marketed a practical method of registering color directly on a light sensitive film. In other words, there is no way in which a single photographic layer may be exposed to light of various colors so that the developed image represents the original in color. The nearest approach to this condition might be considered a truly panchromatic emulsion, on which the various colors register in proportion to their apparent intensities, but without regard to the actual color. Thus a red and a yellow-green of equal brightness to the eye would register as equal negative densities after development. All existing color methods are built upon applications of this principle, with artificial methods of separating the images which represent the original colors.

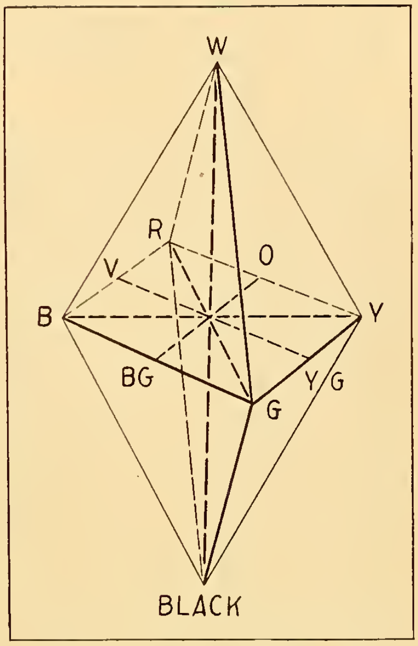


Fig. 2. The Color Pyramid

It was discovered very early that any color could be produced by mixing certain other colors, this fact being an unexplainable phenomenon. From childhood we have been familiar with the expression "primary colors," and take them for granted. However, the phenomenon of primary colors is a mystery, in view of the well founded wave theory. We might as well expect that we could choose three pure tones in sound, and by proper proportions of these three tones produce any tone in the entire band of audio frequencies. The availability of primary colors may be considered somewhat of a blessing, since without it we could not produce color images which would have a definite relation to the original.

A System of Analysis and Synthesis

Color photography may be considered as adaptation of ordinary photography to the successive steps of color analysis and color synthesis. Color analysis leads to the production of "color separations" in place of the usual single negative of the subject. Color synthesis covers all methods of utilizing the color separations in order to reproduce the colors from the separations. Usually there is very little relation between the two methods combined into a single process, but in some cases they are closely related.

It may be stated in general that any synthesizing method may be utilized to produce a print from any analyzing method, regardless of the trade name used to blanket the two, provided the color separations have been produced with essentially the same division of the spectrum. This limitation is particularly applicable in the case of three color separations, where a number of combinations are possible, but since these are not yet available for motion picture work, they may be ignored for the present.

Two Color Processes

All professional work to date has been done on so-called "two color" processes, due to the relative simplicity of the problem as compared to true three color. It should be understood that a two color process, by its very nature, is incapable of reproducing true natural color. Two-color processes are, at best, approximations of natural color, and can never be anything else. Great care has been exercised in choosing the two colors to be used, with the result that orange-red and blue-green are universally accepted as representing the best that can be done without the third element.

In choosing the orange-red and blue-green combination, it has been first assumed that the two colors used must be capable of producing both black and white, with a complete scale of grays, these things being very common in nature. Since people are most interested in other people, it was necessary that a good approximation of flesh tones be produced, as well as of hair texture of the several complexions. The combination used happens to meet these requirements, and at the same time give fair foliage tints, earthy browns, and brilliant reds. It is of interest to note that these are all approximations, at best, except where the original tints happen to coincide exactly with one or the other of the color registers. By the law of averages, the chance of such coincidence is nearly zero.

The Complexity of Color

It is to be hoped that the reader will not be confused by the circle diagram herein represented, since it will fall far short of explaining the true situation in color mixing. From a scientific viewpoint, there is much in color which is still unknown. Each branch of science has its own method of representing color graphically, and no real agreement has been reached on the subject.

The science of psychology favors the interpretation offered by the "color pyramid" shown in Fig. 2. It is claimed that every possible color, of every possible intensity, may be found in or on the pyramid. Consider the pyramid as a solid, in which each particle represents a given proportion of color and intensity. This diagram is offered here, not as a practical scheme for comprehending color film processes, but as an indication of the infinite complexity of color and color combinations, in the hope that the reader will have sympathy and understanding of the magnitude of the problem which faces those patient researchers in motion picture photography in color.

(*To be continued*)

Perfect Changeovers

By M. H. Goldberg

SINCE the adoption of the Standard Release Print and its acceptance by all members and divisions of the craft there has been much discussion regarding its advantages and its disadvantages. Champions of the standard cue marking and footage were of the opinion that individual marking of the film for start motor cues and changeover cues would be a thing of the past—that punch marks, chalk marks, clicker patches, foil contacts, and scratches would no longer disfigure the ends of the reels. While these conditions are indeed greatly lessened, there is nevertheless a great deal of film disfiguration still in evidence.

Causes of Disfiguration

An investigation of the situation reveals that this practice of individually marking film ends is attributable to several distinct causes. The principal cause is that of fear—fear that the dots will run through without being seen. To obviate that fear, projectionists have marked their reels for better visibility.

Other reasons for the practice may be listed as: Timing for the difference in the pickup speed of various machines. Difference in technique. Individual practice and preferences of projectionists on shifts and differences among shifts. The cutting and removal of film, either on cues or after. Indecision caused by a variety of scratches, punchings and other markings put in during many runs.

A New Method

These are a few of the many causes which really should not affect operation, but which in practice very often do so. In the breadth of this country there are without a doubt many personally made devices and personal methods most of which tend to disfigure the prints. If these can be replaced by a method which will reduce disfiguration to an absolute minimum, even permitting the size and the number of the present dot markings and at the same time affording the projectionist a positive means of identifying them for start motor and changeover cues, then it must be admitted that a great forward step has been taken. Such a method may, it is believed, be found in the use of the GoldE Three Alarm.

The device consists of three duralumin arms, light, strong and durable. These arms are provided with adjustable rollers and a locking device for micrometer setting. The arms are mounted on a bearing arm which in turn is pivoted the mounting plate with a spring locking pin. The entire assembly is easily fastened to the inside of the upper magazine and is so designed as to permit the use of the largest size reels. The parts are accurately machined and the whole becomes in effect a micrometer caliper for three diameters. In operation, three distinct alarms are given, one as each arm drops against the side of the magazine. The first alarm is a general warning, the second is the start motor warning and the third for the changeover. The mechanism is simple and positive in operation and requires only a first survey of the reels used.

Reel Hub Sizes

The warnings are pre-set for the particular equipment's pickup speed and the diameter of the reel hubs in use. The hub diameters must of course be exactly alike for the method to work. A method has been developed for checking and correcting reel diameters which, once the operation has been performed, need never be repeated. Reel hubs have been checked in hundreds of theatres. Two general diameters have been found, namely, two-inch hubs and five-inch hubs.

The five-inch hubs as manufactured at the present time are accurate and applicable to the Three Alarm method. Where a variety of hubs is used, a method has been devised for building up the diameters. Reel diameters may be simply and accurately checked by cutting a length of film which will exactly meet and butt when wrapped once around the hub.

As may be expected, the length of the film from the changeover to the end of the reel must be alike on all reels. It has been found that each film manufacturer has adopted a trailer which is standard for the reels which he produces, in fact, the length of film from the changeover to the end of the reel is kept surprisingly close by all film manufacturers. It is expected soon that a common standard will soon be adopted by all film companies.

Present Limits Satisfactory

Even at the present time the GoldE device will operate with entire satisfaction within the limits established. In exceptional cases, a little checking on the part of the projectionist before the first show will enable him to see that all reels are alike. This is merely a matter of counting the turns of the reel or the rewind handle from the changeover to the end of the reel. A variation of two feet or less will not interfere with the operation of the alarm. More or less variation as between subjects or features, when running more than one, can be equalized on the film.

Sound Head Optical Systems

By R. J. STIER †

No single item of the sound reproducing equipment is guarded with more jealous care than the sound head optical system. Projectionists have repeatedly been warned by the sound equipment manufacturers not to tamper with it—that its adjustment is critical and a task for the sound engineer alone. In the following article Mr. Stier explains the sound head optical system and describes the important function it performs in sound-on-film reproduction.
—THE EDITOR.

QUITE contrary to general opinion, there is nothing of mystery about the sound head optical system as it is used in the average theatre reproducing equipment. It is true that contractual obligations enjoin the theatre owner from authorizing or permitting the projectionist to make adjustments on optical systems he feels are out of proper adjustment. These obligations are included for the universally recognized reasons that the highly trained service engineer can, most advantageously, unerringly locate the causes of troubles which appear to sound as though they were occasioned by faulty optical system adjustment and correct them to the best interest of all concerned.

Special Training Required

In addition to specialized technical training, optical system adjustment normally requires the use of a special test film, meters (or equivalent apparatus) and keen discriminatory judgment. As a concrete illustration: faulty optical system adjustment causes poor quality sound distinguishable to the trained ear by the lack of "brilliance" or "sibilance" in the upper frequency range. Under some conditions a faulty amplifier tube which, because of age has lost certain of its characteristic qualities, will cause a similar sound output to result. Obviously, adjustment of the optical system would be no cure for this particular trouble and would, in fact, aggravate it.

The purpose of this article, then, is to explain the operation of the optical system and to describe means of adjustment in order that some of the mysteries surrounding this piece of apparatus may be removed. This information is offered to enhance the projectionist's general fund of information only and in no wise conflicts with the instructions in force at his theatre.

Since such adjustments are delicately balanced, and since a misadjustment of the order of 0.001 inch may cause the difference between satisfactory and unsatisfactory sound, the wisest course is easily apparent; let the well-equipped service engineer keep this equipment in adjustment.

While, popularly, only the "lens barrel" is spoken of as the optical system for purposes of completeness this discussion will include the source of light, i. e., the exciter lamp and the photocell. Under these conditions, then, the complete optical system consists of the source of light, the lens barrel, and the photocell.

Purpose of Exciter Lamp

The function of the exciter lamp is that of furnishing a steady, intense source of light. In its ideal form, the exciter lamp filament would be simply a straight line, horizontal, parallel to the plane of the film, and perpendicular to the direction of film travel. Since a lamp filament consisting of a straight piece of wire would not yield sufficient light for the purpose, and, in addition, would sag considerably when heated to incandescence, thus introducing a variation in focus, the filament of the exciter lamp used today generally consists of a very closely wound tightly coiled tungsten wire. The axis of the helix formed by the filament wire is in the horizontal plane and the lamp is so positioned as to meet the requirements mentioned above, namely, it is parallel to the plane of the film and perpendicular to the direction of film travel.

Because of its heaviness and relatively low operating temperature the exciter lamp has a reasonably long life and is an extremely brilliant source of light. In the case of reproducing equipments fully alternating current operated and having no rectifiers to supply the exciter lamp, the filaments of the exciter lamps are made considerably heavier and are operated at higher current values. The thermal inertia of the lamp is, in these cases, increased and the light emitted by the lamp does not vary with rapid fluctuations of exciter lamp terminal voltage with the result that undesirable "hum" is greatly reduced.

Components of Lens System

The "lens barrel" proper contains two condenser lens assemblies and a slit. The slit consists of a pair of knife edges micrometrically set in position. They must be absolutely parallel and must be separated by precisely the distance required by the design of the optical system. If the distance separating the knife edges is too great, even though they be parallel, the over-all response of the reproducing equipment will vary widely from that desired. Widening the slit has the disastrous effect of reducing the high frequency response of the reproducer; too great a reduction of the distance between the knife edges of the slit actually improves the response characteristic of the equipment but does so at the sacrifice of gain or an increase in amplification required.

In general, a narrower slit possesses a more desirable response characteristic but also requires more amplification to produce suitable sound in the auditorium than does a wider slit, which possesses a less desirable response characteristic, but which requires much less amplification to produce sound of the same intensity in the auditorium. In this matter, as in all other engineering problems, a suitable compromise is effected between the extremes of ideal response with its resulting impractical amplification requirements and the modest amplification requirements of a wide slit having a totally unsatisfactory response.

Width of Slit

Slits in commercial usage today are of varying width. However, nearly all, in combination with their condensing lens assemblies, result in a light beam whose width is approximately 0.001 inch at the point at which the light beam strikes the sound track of the film. It will be seen readily that a slit having a width of 0.005 inch used with a lens having a reduction ratio of 5 to 1 will result in the same width light beam as will a slit having a width of 0.0015 inch used with a 1½ to 1 reduction lens—all other conditions being equal. In addition, the use of the wider slit and greater reduction power lens offers one advantage of adjustment not possessed by the smaller slit and lens assembly which is that any given variation from perfection in adjustment affects, on a percentage basis, the resultant width of the light beam at the film to a lesser degree.

To understand the necessity for a narrow slit (or light beam) consider, for a moment, sound as it is recorded on the film. Standard film speed for sound pictures is ninety feet per minute. If that figure be reduced to terms of feet per second the answer will be found to be 1.5; or eighteen inches per second. Now, if sound be recorded on this film continuously for one second it will always fill eighteen inches of length on the sound track. This is true regardless of the frequency (or number of complete vibrations per

(*Continued on page* 33)

---

† Engineering Dept., RCA Photophone, Inc.

Standardization of Picture Apertures

The following specifications for the standardization of picture apertures as proposed by the Academy of Motion Picture Arts and Sciences have been submitted by Mr. Lester Cowan, executive secretary of the Academy. That the proposal represents a step in the right direction is indicated by the fact that several of the leading studios have signified their approval of the proposed change. Should the proposed standards be adopted, it will mark the elimination of one of those vexing problems which have confronted the industry since the advent of talking pictures.—THE EDITOR.

THEATRE screens will be a standard shape for the first time since talking pictures if a proposal favored by the Hollywood studios is adopted. Improved photographic effects and more efficient use of the image space on the film are expected to result.

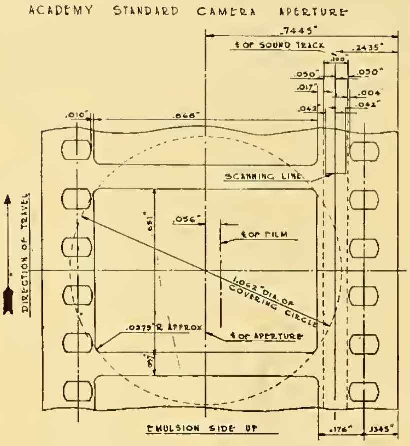


Fig. 1. *Academy Standard Camera Aperture*

The height of all screens will be three-fourths the width, a proportion first established by Edison in 1889 and used until three years ago when the sound track was put at the side of the film and the picture consequently became more nearly square.

Survey Being Conducted

A majority of the studios have ratified standardizing specifications drawn up by the Academy of Motion Picture Arts and Sciences. Theatre practices are now being surveyed and if the change is found to be practical for a majority of theatres, pictures photographed according to the new dimensions will probably be ready for release by the first of the year. In the meantime all theatres will be given detailed data from which to make the comparatively slight and inexpensive changes in projector apertures and screen masks which will be necessary to bring about uniformity.

Studios which have notified the Academy to date that they are in favor of making the proposed change include: Educational, Fox, Hal Roach, Metro-Goldwyn-Mayer, Paramount-Publix, RKO-Pathe, RKO-Radio, United Artists, Universal and Warner Brothers-First National.

Will Settle Production Difficulty

The establishment of uniform three-by-four proportions for theatre screens is expected to settle a production difficulty which has vexed studios and theatres since the sound track method of recording was introduced. The studios have had to photograph actors and scenery so that the picture could be shown on an oblong screen in some theatres and a virtually square screen in others, depending on the method of sound recording used and other mechanical factors. This has frequently resulted in part of the top, bottom or sides of the picture image being cut off the screen.

The new standard is expected to do away with framing difficulties and to permit the studios to use four per cent more area on the film for dramatic action than was possible while variation in the shape of screens had to be provided for. Extensive research and study by an Academy committee of studio and theatre technicians were necessary to determine the exact specifications as allowances had to be made for progressive shrinkage in the film stock and accuracy of registration in cameras, printers and projectors. The camera aperture proposed is .651 inch by .868 inch, allowing for a theatre projector aperture of .615 inch by .820 inch.

Basis for Standardization

This is the second step in the standardization of apertures begun by the Academy in 1929. It is made possible now by the decrease in the use of sound-on-disc and the increasing number of theatres which use a reduced three-by-four proportional aperture.

The original Academy specifications were made to take care of an emergency situation. A large number of theatres using sound-on-film had given up the nearly square movietone screen shape for mechanical and other reasons and were insisting on using a reduced aperture in three-by-four proportion. Consequently the heads and feet of characters were being cut off since the studios at that time were photographing for the full height of the frame.

The Academy made a national survey of the situation and found that something had to be done although there was still so much full frame disc release that it was too early to standardize. As a temporary measure the Academy then recommended that all vital action be kept within a three-by-four rectangle marked on the camera glasses of such size that the picture would not suffer when projected through a reduced proportional aperture. For the past year cameramen have thus had to fill about twenty per cent of their frame—the ten per cent of sound track area, five per cent at the top and five per cent at the bottom—with non-vital action or unessential views of the set.

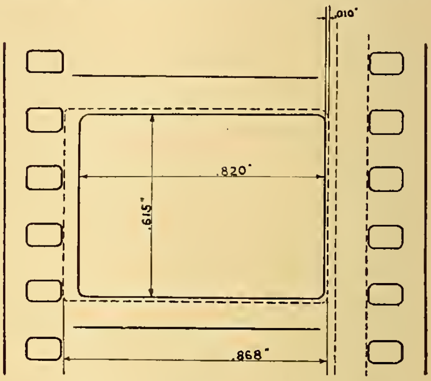


Fig. 2. Projector Aperture

The proposal now is to mat off this useless space in the camera and standardize the American industry on the three-by-four picture proportions preferred by the theatres. By careful calculations it has been found possible to use a little more image area on the film than has been included inside the marks on the ground glass and thus give four per cent more image area for vital dramatic action to reach the screen.*

The proposed standard apertures for all pictures are:

New Camera Aperture: .651" x .868"
(Corners to be rounded by an arc of a circle of .0279" radius.)
Replacing the present:
Ground glass markings of .620"x.835" in the Mitchell aperture of .720"x .923" and the Bell & Howell aperture of .720"x.969".

New Projector Aperture: .615" x .820"
Replacing the present:
Most commonly used proportional of .600"x.800"; Movietone aperture of .680"x.800"; Old silent aperture of .680"x.906".

Cinematographers estimate that from a half hour to an hour a day now spent in setting up for composition in three apertures—full frame, movietone frame and proportional—can be saved or devoted to improved photography.

---

*Note: The question of the relation of the motion picture aperture to a possible aperture for television was brought to the attention of the subcommittee by the Television Committee of the Radio Manufacturers' Association. The standard specifications allow for an adaptation to the requirements of television when such adaptation may be commercially desirable.

Scaffold lights can be lowered from three to five feet, thus making possible a reduction in the wattage or number of units.

The tops of large sets can be lowered by as much as six feet and all sets can be reduced in width by nearly ten per cent without making any change in the placing of essential action and props as photographed for the past year.

Improved Quality

A single aperture will make for better composition on the set for both the cinematographer and the director.

The studios will be assured that the picture will be projected as it was photographed. Projectionists have had wide leeway in framing and no guide to show them when their proportional aperture was centered until they saw heads or feet cut off on the screen.

Microphones can be lowered from three to five feet, resulting in an obvious advantage in sound quality and convenience for the sound department.

Camera lenses can be recentered on the new aperture for better optical coverage.

Advantages in the Theatre

All pictures can be projected through a single standard aperture, doing away with movable flippers and changes of screen masks, aperture plates and lenses during the show.

The frame lines just outside the aperture as they used to be for silent pictures will be a help to the projectionists in keeping in correct frame. If the picture should momentarily go a little out of frame the projectionist will be warned by seeing a frame line, but as the lines are wide the misframe can be corrected before the audience notices it.

Standardization of exact dimensions by the studios will give the projectionist more uniform prints from the various companies.

Theatres now using reduced proportional apertures will gain four per cent more screen image without additional magnification.

Theatres now using the movietone aperture or the old silent aperture will gain the advantage that the studios can fill the whole area of the new standard aperture with essential dramatic action and will not have to leave a border of unimportant picture.

Changes Required in Studios

In Cameras

New apertures at a cost of about $25 per camera.

New ground glasses.

Adjustments to recenter lenses.

In Laboratories

Minor adjustments depending on the present practice followed by the laboratory.

In Art Departments

New camera angles.

In Viewing Rooms

Adjustment of projector apertures and screens.

Changes Required in Theatres

1. Theatres now using reduced proportional apertures:
   a. File out apertures to larger size or insert new plates.
   b. Enlarge screen by about four per cent of area.
2. Theatres now projecting in movietone proportion:
   a. Insert new aperture plates.
   b. Either move the screen masks in from the top and bottom or
   c. Install shorter focal length lens and widen the screen.
3. Theatres now projecting full frame silent or full frame with disc sound:
   a. Insert new aperture plates.
   b. Recenter head of projectors.
   c. Either move screen masks in on all sides or
   d. Install shorter focal length lens to enlarge image to present screen.

Detailed Specifications for Proposed Standard

Specifications for the standardized apertures as worked out by the subcommittee in consultation with studio and equipment company technical representatives are shown in the drawings.

Camera Aperture (See Fig. 1.)

The dimensions indicated provide the maximum aperture which will leave an adequate margin of safety. It should be emphasized, however, that laboratories should print both picture and sound track with the greatest possible accuracy. In the drawing the center line of the right-hand side sprocket holes is used as the base center line for calculating all dimensions, since cameras and printers register at this point.

Projector Aperture (See Fig. 2)

The projector aperture dimensions have been stated on the basis of projection on the level as no uniform provision for the keystone effect can be made. The calculations have been carried out with due regard to the fact that in projectors the film is controlled at its right-hand edge.

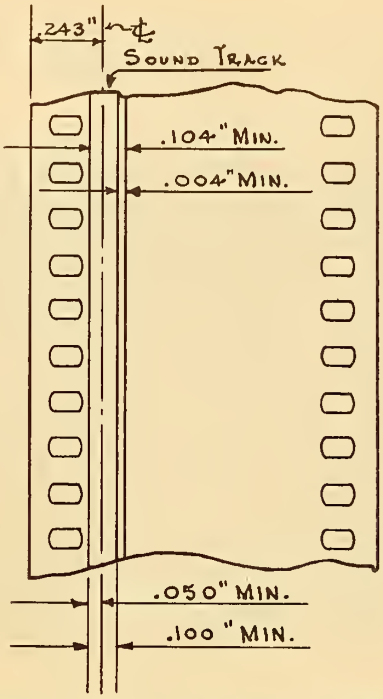


Fig. 3. Detail of Minimum Requirement for Sound Track

Sound Track (See Fig. 3)

The drawing is a detail from Fig. 1 to show the minimum requirements for sound track width and location which were agreed upon by the heads of the studio sound departments and incorporated in the subcommittee specifications.

Minimum and Maximum Sound and Picture Areas

Fig. 4 is a composite view of the dimensions resultant from the calculation of shrinkage and mechanical tolerances from which Fig. 1 was derived. Some of the factors and conditions considered are given in the following analysis by J. A. Dubray of the subcommittee:

For Negative Films

a. The plus and minus camera tolerances which include the location of the aperture (constructional tolerances), the size of the aperture (constructional tolerances) and the side weave of the film on the register teeth of the intermittent mechanism.

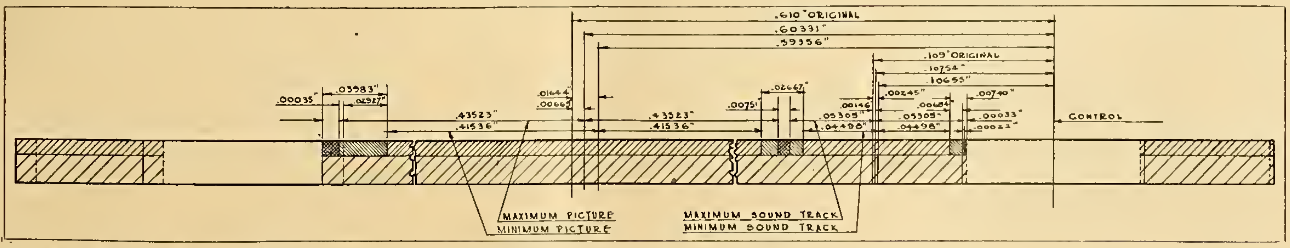


Fig. 4. Minimum and Maximum Sound and Picture Areas of Positive Using Sprocket Center Line for Register

b. The plus and minus tolerances which must be allowed in accumulating the camera tolerances with a one-half per cent film shrinkage.

For Positive Films

c. The plus and minus tolerances required in printing a positive and calculated first from the effect of registering the positive film against the right-hand side of the teeth of the main printer sprocket while the negative registers against the left-hand side; second from the effect of registering the positive and the negative films in the opposite direction. Both cases for unshrunk positive and accumulating with the tolerances arrived at (b).

d. The plus and minus tolerances calculated from the (c) tolerances plus a positive film shrinkage of one-half per cent.

e. The plus and minus tolerances calculated from the (c) tolerances but with the addition of a positive film shrinkage of one and one-half per cent.

The results obtained from the above have been derived with the assumption that the negative has only shrunk one-half per cent.

However, since the shrinkage effect constantly progresses through the printing process as well as while the films are stored away, the calculations have been extended to include a greater negative shrinkage.

Accumulated Tolerances

The following series of computations was carried accumulating the plus and minus camera tolerances, with the tolerances necessitated by the various conditions expressed above, with the exception that a maximum one and one-half per cent shrinkage of the negative was considered instead of the minimum one-half per cent.

For Negative Films

a′. Camera tolerances same as for (a).

b′. Tolerances resulting from accumulation of (a′) and one and one-half per cent negative shrinkage.

For Positive Films

c′. Tolerances required in printing with unshrunk positive for both conditions of film registration expressed at (c), but accumulating tolerances calculated at (b′).

d′. Tolerances calculated through the accumulation of tolerance at (c′) and one-half per cent shrunk positive film.

e′. Tolerances calculated through the accumulation of tolerances (c′) and one-half per cent shrunk positive film.

The latest being the extreme case, accumulating a maximum permissible shrinkage and all constructional and register tolerances taken from the camera, the registering tooth, the processing of both positive and negative and those of the printing of the positive film, which are due to the differences in shape and dimensions of the positive and the negative perforations.

The above method of determining shrinkage and mechanical tolerances has resulted in the determination of a maximum camera aperture as illustrated in Fig. 1.

Talking the above dimensions and computing according to the accumulated tolerances determined at (d), (e), (d′) and (e′), the maximum and minimum dimensions of sound track and picture area of positive film are derived as shown in Fig. 4.

Possible Objections to Proposed Change

A large part of foreign release is now on full frame disc and foreign exhibitors are used to showing American product in this way. This is probably the most important objection to the proposed change even though foreign release is a comparatively small item. However, the same considerations of studio economy will also apply to foreign producers and it is probable that they will follow Hollywood's lead. Foreign theatres now showing full frame can make the same adjustments American theatres have made. If they make no adjustments at all the picture will not be hurt except to show a heavy black border on the top, bottom and left side.

There will be a period when prints with different apertures are circulating side by side. While this is true of any standardization, the committee considered that the advantages will far outweigh any temporary inconvenience. Theatres will be given the necessary instructions in advance and should not make the changes until they begin to receive most of their bookings on the new standard.

Cost to Theatres Negligible

Many theatres are unable to afford expensive changes in equipment. In answer to this it may be pointed out that this change puts no burden on the theatre. The new frame can be projected if necessary without any changes in apertures or screens whatever and the only harm will be that a black border may show around the picture. The theatre can get rid of this by installing new aperture plates at a maximum cost of $3 and putting a rim of black paint around the screen or moving the screen masks in at very slight expense.

If an individual theatre does not want to install shorter focal length lenses and has been showing silent pictures or sound-on-disc pictures through the old silent aperture, the change will reduce its screen size by about eighteen per cent. If a theatre has been showing sound-on-film through a movietone aperture the change will reduce its screen area about seven per cent, unless shorter focal length lenses are installed.

In answer to these statements it should be pointed out: first, that the area being matted off has not contained any vital action during the past year and so has contributed little to entertainment value; second, that standardization of the three-by-four proportions responds to a strong demand from the theatre field; third, that to the increasing number of theatres using a reduced proportional aperture the change will mean a four per cent larger screen image without additional magnification.

Development of Standard

At its meeting, April 16, 1931, the Producers - Technicians Committee heard letters from Albert S. Howell, J. I. Schnitzer, Douglas Shearer, Dr. Alfred N. Goldsmith, D. E. Replogle and G. E. Mather relative to picture apertures. Attention was called to the previous investigation of the aperture problem by the Academy and the possibility that in view of subsequent changes in theatre conditions it might be desirable to amend the specifications established in 1929. A subcommittee consisting of Virgil Miller, George Mitchell, Joseph Dubray, Sidney Burton and Donald Gledhill was appointed.

After securing preliminary data through a questionnaire, the subcommittee recommended that a conference of studio representatives be called. This was held on June 18, the following studios being represented: Fox, Metro-Goldwyn-Mayer, Paramount-Publix, RKO, Universal and Warner Bros.-First National.

The conference endorsed a three-by-four proportion for motion pictures and recommended that specifications be drawn up for standard apertures on this basis.

A questionnaire to the sound departments securing data for the standardization of sound track width was followed by a conference of the heads of sound departments on July 21. The following studios were represented: Metro-Goldwyn-Mayer, Columbia, Warner Bros.-First National, Paramount - Publix, Metropolitan, RKO, United Artists, Universal Educational, and RCA Photophone, Inc., and Electrical Research Products, Inc.

On July 24 a questionnaire was sent to the studio and commercial laboratories.

The subcommittee then undertook to draw up specifications which made sufficient allowance for shrinkage in the negative and positive and the various weaves and tolerances which must be considered and at the same time to secure the largest possible useful image area on the film. In the necessary research and experimentation the subcommittee was particularly assisted by the full cooperation extended by the Paramount Camera department, Metro-Goldwyn-Mayer Sound Department, Bell & Howell Company, International Projector Corp., and Consolidated Film Industries.

On October 6 a meeting of studio

(*Continued on page* 34)

Nearing the Television Goal Line

By HERBERT S. FUTRAN

There has been manifest on the part of the general public during the past several months a marked increase in interest toward the subject of television. While it may not perhaps be said that the man in the street has become television minded, he has, at least, become television conscious. Not a little of the interest which has been aroused has been due to the fact that it is now possible to project the televised picture on a screen approximating in dimensions those used in small motion picture theatres. In the following article, Mr. Herbert S. Futran of the Sanabria Giant Television Corporation describes the apparatus and the method by which this greatly enlarged screen image is obtained.—THE EDITOR.

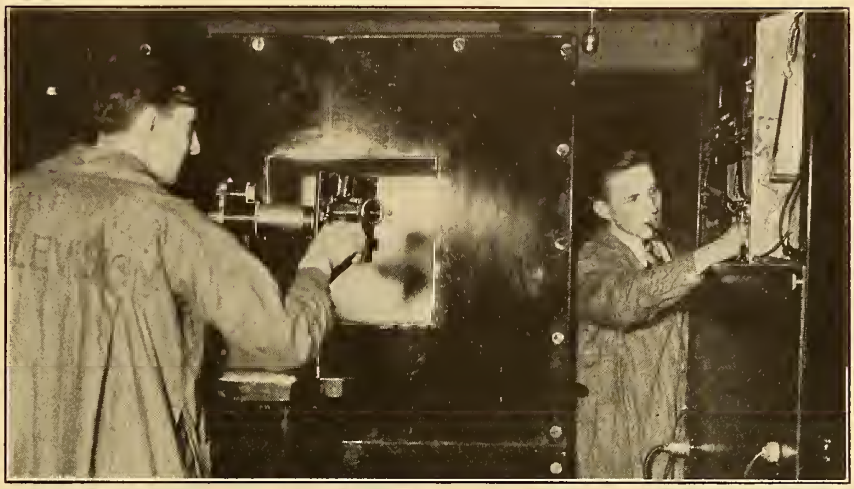


Fig. 1. Engineers Adjusting the Equipment

AFTER years of laboratory experiment, television is evolving into a new form which will ultimately bring its acceptance as a form of entertainment as vital and as universal as the radio and, possibly, even the talking picture.

Recent demonstrations have brought home to an increasing public the realization of the practical possibilities of television. With few exceptions, that very small part of the public who knew anything about television had encountered only the diminutive "peep-hole" pictures which measured but a few inches square. As long as television pictures were no larger than that, the growth of television could be but an experimental development.

Wider Possibilities Demonstrated

In recent months, however, many of the wider possibilities of television have been demonstrated and the public is showing a keener interest in the development of the art of visual broadcasting. One of the most revolutionary developments is the large ten-foot picture which Ulises A. Sanabria of Chicago demonstrated with great success on recent occasions at the Madison Square Garden and during a theatrical engagement of television at the Broadway Theatre in New York.

Experimenters have labored to achieve apparatus capable of transmitting an image which could be shown on an enlarged screen. It remained, however, for this young Chicagoan, who has just recently passed his twenty-fifth birthday, to pave the way with his ten-foot picture, which is the largest image ever shown to the public. The many thousands who saw the apparatus during the recent demonstrations have asked how Sanabria achieves so brilliant and so large a picture.

He uses a scanning disc employing only forty-five holes in the apparatus which was used in both the Madison Square Garden and the Broadway Theatre demonstrations, but, by virtue of remarkable developments in his technique, he is able to achieve an astounding degree of definition. Very minute details such as the bristles in a man's beard, the design in his cravat or the reflection of his spectacles are reproduced with startling fidelity.

It is obviously impossible to broadcast a picture as a unity. It is necessary to "break up" every picture into smaller elements which can be translated into electrical impulses. This process of decomposition is achieved through scanning.

The "Flying Spot"

A single beam of light is projected through a disc perforated with a series of holes, in a spiral arrangement, which moves at a speed of 900 revolutions per minute. The light which penetrates the disc is known as the "flying spot" and is reflected, through a mirror, on to the face of the subject being televised. The holes in the disc being arranged in spirals, each spot of light is reflected to "hit" a different but consecutive cross section of the subject.

Thus, through the use of scanning, every image is broken into these smaller elements which can be transmitted over the air. It is necessary, however, to translate these picture elements into some form which can be amplified and sent across great distances. Placed before the subject is a bank of platter-like reflectors which house the photo-cells, caesium cells sensitive to light which are capable of translating light into electrical impulses.

These photo-electric cells radiate impulses which are the electrical equivalents of various graduations of light and which vary in intensity to the shade of light. Thus, with a dark color the corresponding impulse or signal is a weak one, darkness being an absence of light. Conversely, the lighter the color, the more intense the signal. The photo-electric cell acts in the same capacity as the microphone in sound broadcasting.

In radio transmission the microphone translates each sound into a corresponding electrical impulse which is amplified and sent over the air. Sound as sound has only a limited carrying distance and could not as such be transmitted. Similarly, the light radiated from any one subject is not intense enough to carry through space without being eclipsed by the welter of other light sources. Following its translation into elec-

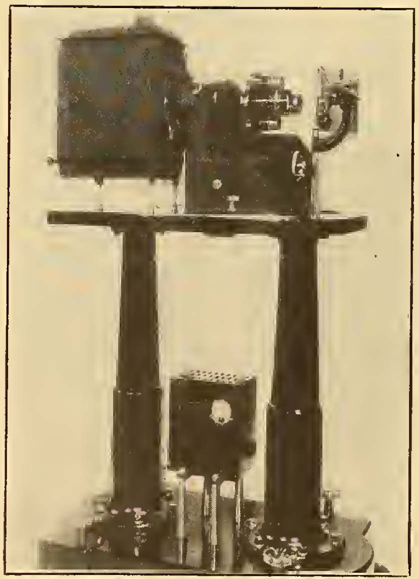


Fig. 2. Flying Spot Mechanism

trical signals light takes on the same form as sound departed from the microphone. In fact, were one to tune in on a television broadcast with headphones he would hear a series of connected but seemingly meaningless sounds which would resemble nothing so much as a wide range of buzzing noises emanating from a sawmill.

Special Receiver Used

A special receiver, however, intercepts the television signals which are wider and carried along a lower wave length than regular radio signals. A highly sensitive light source reconverts the signals into graduations of light. This light makes possible the remarkably brilliant pictures which Mr. Sanabria has been able to demonstrate.

It is a small point-source lamp, not much larger than a type 250 radio tube. It is air-cooled and produces a whitish picture which is a distinct improvement over the red images of the ordinarily used neon lamp. It is capable of one hundred per cent modulation, responding to as many as 100,000 light variations per second. In the recent demonstrations of Sanabria television this lamp has withstood the rigors of regularly scheduled demonstrations. Not once in fifty-six demonstrations at the Broadway Theatre was it necessary to halt a performance because of mechanical difficulties.

Light Projected on Screen

The light from this glow lamp is projected on to the screen by means of a disc, similar in design and in the arrangement of the perforations along the circumference to the scanning disc at the transmitting end. In each perforation there is a lens three inches in diameter which magnifies each spot of light and projects it on to the screen. The motor operating the disc at the receiving end is synchronized with the power source at the transmitter.

In no instance does the eye perceive a complete picture. There are a series of these spots of light which follow one another at so swift a pace that there is an optical illusion of a complete image. What is actually seen at any one time is one spot of light to which the eye clings until that spot merges with the next spot and so on until all of the constituent parts of the picture have flashed upon the screen at which time another picture is started. In every second fifteen distinct pictures flash upon the screen and each one of these pictures has approximately 2,500 elements.

There are several reasons why Mr. Sanabria's images have been so widely acclaimed as superior developments in television engineering. The amplifier has the capacity of amplifying each impulse 2,000,000 times. It is the heart of the television system and is responsible for the startling amount of definition which Mr. Sanabria achieves. It is possible even to retouch the television images just as an artist would retouch a photograph. This retouching, of course, is done electrically and occurs instantaneously while the broadcasting is taking place.

Universal Acceptance Inevitable

The acceptance of television as universally as sound broadcasting now is accepted as inevitable. For the time, however, there are many problems which must be solved. It is difficult to say at this time whether the scanning disc system which Mr. Sanabria has used so efficiently in his theatre apparatus will prevail to the exclusion of the so-called electrical scanning or cathode ray systems or whether it will ultimately give way before this newer system.

Fig. 3. View Showing Photocells

Mr. Sanabria himself, despite the applause given the recent performances of his apparatus, has retired to his laboratories to develop completely new forms of television. He has worked with success in cathode ray developments and has produced a new system which utilizes the best features of both cathode ray and mechanical scanning. "Which system will ultimately prevail," Mr. Sanabria says, "I cannot say. For the purposes of theatrical presentation I feel that the scanning disc system such as the one we are now using is highly satisfactory, but great progress has been made in cathode ray experimentation and, as time goes on, that system might become the system for the home."

As in every infant industry there is still a whole world of development work yet to be done. Through the presentation of Sanabria television units in theatres throughout the country, it is hoped that the public will be made "Television-conscious." Only a fraction of the population of this country has encountered television in any form and, before television can make great progress, it must be supported by a public interest.

There are problems of presentation and it is here that the television experimenter will ally himself with the talking picture man. There is yet to be developed a suitable technique for the development of talking pictures for television which will serve the same purpose as electrical transcriptions in sound broadcasting. For a long time to come television broadcasting will be confined to local origins, network broadcasting being at all possible after much more experimentation. Therefore, some such medium as the motion picture film must be used.

Film is eminently successful as a television subject. The eye of the camera is much more exhaustive and encompassing than that of the television apparatus and much better pictorial results are achieved because of the advanced technique of motion picture production. One film can be syndicated to a hundred television broadcasting stations and the cost of casts of actors, settings for plays and the necessity of overcoming the problems of presentation are eliminated.

New Sound Film Transmitter

Mr. Sanabria has recently developed a talking film transmitter which was the cynosure of the many motion picture operators who attended the radio show at Madison Square Garden recently. In this transmitter a regular sound film can be transmitted over the air. Unlike some of the other film transmitters this one broadcasts talking pictures with the sound on the film rather than on a disc.

A powerful Mazda light is used in the transmitters and the light originating in the lamp is broken up by a scanning disc similar to the one used in the regular scanning mechanism. The fragments or spots of light are then cast upon the film and a single photo-electric cell is used to pick up the light which filtered through the celluloid.

The scanning disc used in the Madison Square film transmitter was of forty-five holes. It runs at fifteen frames a second in a proportion to the speed of the film, which obviates the necessity for a shutter inasmuch as the film moves continuously and not intermittently as in the regular screen projection. The sound being picked up off the film in the regular manner, the effect when received over the air is comparable only to that of the talking film when projected in the motion picture theatre.

A Distinct Form of Entertainment

As time goes on, television will become increasingly independent in its technique, withdrawing from both the theatre and the motion pictures in the evolution of a distinctive form of entertainment. Television will never efface talking pictures just as talking pictures never supplanted the theatre. It will, however, draw upon the resources of both stage and screen in its development.

(*Continued on page* 36)

The Use of Resistance in Arc Circuits

By WILSON G. BOYDEN

In this month's issue the author concludes his dissertation on the use of resistance in arc circuits with a consideration of the application of booster circuits, rheostat installation, points to bear in mind when ordering resistance equipment and the desirability of simplicity of control. Mr. Boyden is an electrical engineer and a member of the Engineering Staff of the Ward Leonard Electric Company. —THE EDITOR.

PART II

IN arc circuits having a maximum current exceeding 110 amperes, it is advisable to reduce the starting current to some value lower than that used for normal operation in order to avoid fracturing the carbon due to inrush current, when the arc is struck and to obtain a satisfactory crater in the positive carbon. To provide the reduced current, usually from ½ to ⅔ of normal current, an extra terminal is placed on the rheostat. The fixed section of the rheostat is generally connected to this terminal thereby providing a circuit in which the current is limited to the minimum current as specified on the rheostat name plate.

Two wires from the rheostat are carried to the lamphouse and connected to knife switches as shown in Fig. 4. The lead from the fixed section of the resistance is connected to one side of the double pole switch and the lead from the variable section to the booster switch. Then the current in the circuit when striking the arc after closing the double pole switch is a minimum. After the carbons are warmed and the crater formed, the normal current is supplied by closing the booster switch.

Purpose of Booster Circuit

The use of the booster circuit increases the importance of the minimum current specified for the rheostat. For example, a rheostat having a rating of 60-180 amperes normally operating on 150 amperes would have a warming-up current of 60 amperes. This current is too low to be practical with carbons rated at 150 amperes, but by fixing the minimum current at 90 amperes, the desired heating and burning would be obtained. However, the boosting current need not limit the specification of the minimum current because it is always possible to obtain any desired current below this value.

A rheostat rated at 150-210 amperes may be connected so as to furnish a warming-up current of 60 or 90 amperes by supplying an extra terminal. With the increased use of higher amperages in arc circuits the use of booster circuits will become more general. Lamp house manufacturers are furnishing equipment with the necessary switches as standard for all Hi-Intensity lamps. Standard rheostats are now supplied with the extra terminal for the connection to the booster switch on all capacities above 90 amperes.

Installation of Rheostats

The use of increased current on arc circuits in order to provide suitable light on porous screens results in higher wattages in the ballast rheostats than was the practice before the use of sound in the theatre. The present trend in theatre design is to provide separate rooms for the rheostat equipment fitted with suitable racks for mounting the rheostats above the floor level and equipped with fans and ventilators for providing continuous air circulation.

Under any circumstances, it is important that sufficient ventilation be provided to carry off the heat given off by the rheostats, and that the rheostats be so placed as to insure free circulation of air through the resistance elements. The fact that a rheostat becomes heated, when carrying current, is to be expected as its function is to dissipate energy in the form of heat, but it must not be placed in such a position or covered over so that the heat cannot be freely radiated.

Rheostats should not be located near inflammable material or in any location providing a fire hazard. If possible, it is well to provide at least one foot of free air space on the sides and back of the rheostats. Local Underwriters' requirements or codes will govern all installations, but it is up to the projectionist to keep the rheostat room free from inflammable material, fans operating, and ventilation through and around the rheostat unimpeded.

How to Order Rheostats

In writing specifications for projection arc rheostats information as to the supply voltage, the maximum and minimum arc current and the arc voltage should always be included. The supply voltage may be obtained from the motor generator or converter nameplate or if the current is taken from the distributing lines of a power company a voltmeter may be used to measure the voltage. The lamp house or carbon manufacturers are in the best position to recommend the correct values of arc voltage and current.

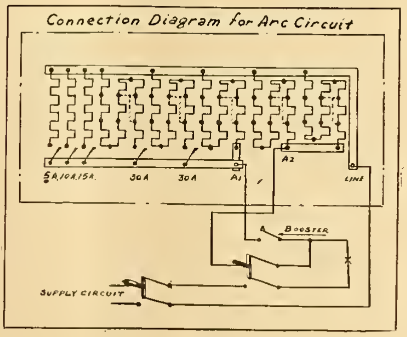
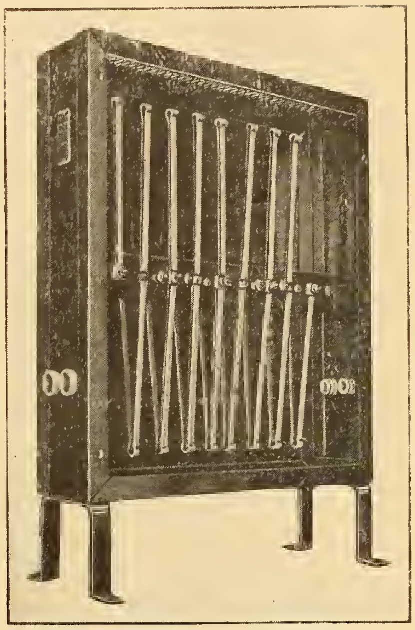


Fig. 4



Typical Arc Rheostat

A Moot Question

Ask a dozen projectionists what the correct arc voltage is for a Hi intensity lamp using 13.6 MM H. I. positive and 9/16" cored negative carbons operating at 125 amperes. The answers will be the same only in the case of those who answer "I do not know." Ask lamp house manufacturers and the carbon manufacturers the same question, and you will be surprised that such a lack of agreement exists.

Go out with a voltmeter and measure the actual arc voltages under operating conditions and you will have some interesting results. At a theatre in A, we find the voltage to be 63, while an identical lamp house operating under apparently similar conditions, using the identical carbons and same value of current, at a theatre in B shows a voltage of 83. The projectionist at A is entirely satisfied with the results while the one in B complains that his rheostat, which is exactly the same as that used in the theatre at A, is not delivering the current. Since it was designed for an arc voltage of 65, how could it?

Still everybody expects the rheostat manufacturer to make a rheostat that will fit both applications.

Let us consider what that means. First, the supply voltage was 100 in both cases. At "A," the rheostat drop, which is the difference in voltage between the line and the arc, was 100 minus 63 or 37 volts. In the case at "B" it was 100 minus 83 or 17 or less than fifty per cent of "A." It means that with the rheostat at "A" set up for 115 amperes, the current would be approximately 121 amperes, while the arc at "B" would have only approximately 87 amperes using the total output of a 180 ampere rheostat.

We cannot blame the projectionist at "B" for complaining because of the poor light on the screen but suppose rheostats were built on the basis of his operating conditions. Such a rheostat will be satisfactory for his application, but what happens if an identical rheostat is shipped to "A"? Plenty! "Why, man alive, the rheostat gets red hot! Surely that's no way for a rheostat to operate." Everybody looks worried and wonders why. The answer is that if a rheostat is designed for a 17 volt drop and it actually has to drop 37 volts it is only carrying an overload of 475 per cent. This is the reason why manufacturers wish an arc had more definite characteristics so that they could figure on definite and fixed values and that all rheostats operating on similar applications would operate with equal voltage drops.

Standard Values Desirable

The problem would be more serious except for the general cooperation of the projectionists who quickly sense the cause of the effect and either operate the arcs with voltage values in accordance with the present specifications, at least attempt to follow the recommendations of the lamp house manufacturer, or change the connections on the rheostat so that the voltage drop across the rheostat is complementary to that across the arc. However, it would clear the situation if the lamp house and carbon manufacturers could agree to some standard values of arc voltage for various carbon combinations and current ranges.

Another interesting problem that is always presenting itself in one form or another to rheostat manufacturers reads about as follows: "Please furnish ballast rheostat suitable for 180 ampere arc to operate from an 80 volt generator." Have you tried to operate a 180 ampere arc from an 80 volt generator? Yes, it can be done, but only by an expert and then only if the arc voltage is below normal.

Usually a question of this kind is handed back with advice to consult with the generator manufacturer, and it usually returns with the generator voltage specification changed to 100 volts or higher. Probably somebody was figuring on saving a few watts lost in the ballast. Well, those watts are a good investment as they pay for themselves by insuring a steady light on the screen.

"Power House Practice"

Have you ever walked into a rheostat room and noticed the number of switches on each rheostat and wondered why so many switches? Rheostat manufacturers wonder also but the only answer seems to be "it is standard practice." Standard practice be hanged! Why should a rheostat be rated 30 to 200 amperes and look like an old-fashioned power house with eight or more switches for current adjustment when it is going to be used on a 180 ampere arc and might just as well be rated at 140-200 amperes and supplied with four switches and furnished with a 90 ampere tap for warming up the carbons. Who expects to use a 200 ampere rheostat on a 30 or 60 ampere circuit? If the explanation is that 30 amperes is desired for warming up, it can be so furnished but less the extra switches, which, by the way, are not furnished gratis.

Now considering the same 30-200 ampere rheostat, what arc voltage should be used as a basis for the design of the rheostat? If 60 or 65 volts is used, it will be satisfactory for a 125 ampere arc but unsatisfactory for a 180 volt arc with 80 to 85 volts across the carbons. If designed for the latter condition, it will be overloaded on the lower range. The above is perhaps an extreme case taken as an example but every manufacturer meets similar problems quite frequently.

Report of the Screens Committee

Because of lack of space it was impossible to complete the S.M.P.E. Screens Committee's report in our November issue. The information furnished is of great practical value and it has, therefore, been deemed advisable to conclude the report and the discussion concerning it in our present issue.—THE EDITOR.

Illumination

THE study of screen illumination is one of the primary aims of the Screens Committee. We hope to determine average values of brightness encountered in theatres and to discuss these in relation to stray light, print density and physiological factors. Also, we plan to consider and standardize methods of measuring brightness, which, at the present time, because of their lack of uniformity, render the comparison of data difficult. Some information on screen brightness has been accumulated but not sufficient for presentation at this time.

Rear projection is attracting wide attention at the present time in New York and promises to develop into a field of interest throughout the country. The manufacturers of this type of screen are not as yet willing to release engineering information so that we are postponing discussion of this for our later report.

Discussion

PRESIDENT CRABTREE: How are the screens cleaned? If the brush method is used, how are they brushed? Is the screen taken down from its position or is it brushed in place? Also, how is the screen resurfaced? What is the cost of resurfacing in comparison with the cost of the screen? Is it worth while?

MR. FALGE: The screen is cleaned in position with a very soft, long-handled brush. Cleaning is very simple, but is often neglected. Some one in every theatre should be given the responsibility of keeping the screen clean. The cost of taking down the screen, packing and shipping it to be resurfaced, and mounting again is so great that it is better to clean the screen in position. Screens may be resurfaced in a number of ways, the spray process being the most satisfactory. The cost of this treatment varies in different places, from 10 to 20 cents per foot. A new screen may cost from 2½ to 4 times the cost of resurfacing, depending upon the amount of surface to be treated. Screens can be resurfaced satisfactorily, but in general the process is not satisfactory, as the material used for resurfacing becomes yellow and is not always put on uniformly.

Spraying Screen

PRESIDENT CRABTREE: What is the effect of spraying a beaded screen? Is it cleaned by spraying, or were you referring to diffuse screens?

MR. FALGE: I was referring to diffuse screens. No good is accomplished by spraying a beaded screen, as the spraying causes the beads to lose their directive qualities. In general, it is extremely difficult properly to clean screens on account of the wide expanse of the flat surfaces. Beaded screens can be cleaned satisfactorily, but the process is very complicated.

The interpretation of measurements must be left to the discretion of one closely acquainted with the measuring conditions. A general attenuation in loudness, as judged from the measured screen transmission characteristic, greater than 1 db., is not considered tolerable. Although this limit may appear rather stringent, there are many screens available which meet this requirement. It seems advisable to maintain this high standard for sound transmission.

PRESIDENT CRABTREE: Could some solvent be used for cleaning the beaded screen?

MR. FALGE: To a certain extent; but the solvents that have been tried have loosened the adhesion of the beads and so such methods have not been found satisfactory up to the present.

PRESIDENT CRABTREE: The matter of standardizing screen sizes is very important. Has this matter been brought to the attention of the Projection Screens Committee?

MR. FALGE: Yes, but nothing definite has been done about it as yet.

MR. SCHLANGER: The information given in this paper referring to the proper distance between the seats and the screen is very important and should be referred to the American Institute of Architects. In relation to the shape of the screen, I suggest that perhaps Mr. Dieterich might say something about the restful physiological effect of the 3 to 5 ratio on the human eye.

Three to Five Ratio

MR. DIETERICH: Yesterday I briefly mentioned the fact that there is a minimum distance required between the eyes and the screen for comfortably viewing the picture. To go a little deeper into the discussion we must consider the sight characteristics of the eyes, which when plotted assume a peculiar egg-shaped form for each eye. The combination of the two characteristics produces a more or less heart-shaped curve for the combined characteristics of the two eyes—*i.e.*, for binocular vision. If we inscribe a rectangle into the combined characteristics we are led to the classical ratio of height to width of 1 to 1.6.

As long as we have to change the proportions of the visible picture—which we must do sooner or later—we should consider the esthetic demands, because they control to a great extent the reaction of the public, which again influences box-office returns. As long as it is necessary to change the dimensions, I am endeavoring to advocate that we should change in accordance with this ratio. There will be a number of technical difficulties, and problems to overcome, but they will have to be overcome sooner or later, in any event.

Committee's Suggestion

The Standards Committee has suggested a 50-mm. width for production reasons, but we can just as well use the proper proportions for this width as for any other. Mr. Schlanger suggested that when one sits in front of a screen that is 40 feet wide he may come closer than 40 feet. However, this would not place the screen within the "easy" range of the eye. The eye must exert an effort to encompass an angle greater than 60 degrees and although our total vision is limited only by about 180 degrees, it becomes a painful effort to use it to its full extent. Along the horizontal axis of vision, the "easy" range is normally 30 degrees on each side, and along the vertical axis about 10 degrees above and 20 degrees below the horizontal.

If the scheme of Mr. Schlanger is in accordance with these physiological facts, he will find that the spectator will enjoy the picture more than in the past. As to the question of depth perception, the recognition of depth in the wide picture is due to the fact that when one looks at a wide screen, the distances to the edges of the picture are perceptibly greater than the distance to the center, and the eye has to accommodate itself to such different focal values. Therefore, the only means of perception, which is by the final nerve center, would cause a reaction, resulting in a muscular effort to accommodate the eye. Therefore, the wide picture has certain disagreeable effects for the present front seats, but which lessen as the distance from the screen increases. The minimum distance between the screen and the front seats should not be less than the width of the picture.

MR. FALGE: The ratio you suggested is close to the 3 to 5 ratio which I mentioned previously.

Effect of Surroundings

MR. JONES: There was one statement in Mr. Falge's paper I should like to question. In discussing the diffusing type of screen he stated that the brilliance of the screen depends upon the viewing distance. I cannot see why the argument applies to the diffuse type of screen and not to the beaded type. It is quite possible that the brilliance of the screen—that is, the apparent brightness—is to a certain extent influenced by the angle of the screen and by the surroundings. I think it is quite possible—and I know it is true—that whether the screen appears to be more brilliant at one distance that at another will depend upon the surroundings of the screen. I think we should recognize that that characteristic, which may be a true phenomenon, is a characteristic of all types of screens, and I cannot see that it is a characteristic of a diffuse type of screen any more than of any other.

MR. FALGE: What I meant to convey was that this effect is more pronounced in the case of the beaded screen. I referred to it briefly in connection with the beaded screen. As far as the surroundings are concerned, if too much light is present, the pupils of the eyes become smaller and the screen does not appear as brilliant as one would like it to be.

MR. OTIS: Have any measurements been made on the diffusiveness of the screens to color?

MR. FALGE: Do you refer to a particular one of the three types, or to all screens? I do not believe that such measurements have been made.

MR. SCHLANGER: Referring to the shape of the picture and the desirability of retaining the 3 to 5 ratio, it is possible to change the shape of the screen throughout a picture so as to present different geometrical forms—triangular, rectangular, circular, *etc.* I understand that some work has already been done along that line.

MR. DIETERICH: Madame Ducat, the only female member of the Legion of Honor, has invented a new "panel" aperture. Her idea is that everyone who has a sense of the artistic frames a picture or composition according to the composition, and does not take the frame and fill it with the composition.

The frame should be under the control of the cameraman so that he may instantaneously alter the picture frame as desired. This does not depart from the 1 to 1.6 ratio for the shape because this ratio is an esthetically fundamental one from which any number of frame sizes can be developed. Her idea of changing the frame size according to the action has been successfully used because she understands the correct use of the panel frame.

A Progressive Police Dept.

For the purpose of demonstrating the possibilities of sound motion pictures in recording confessions and other evidence of importance in police department activities and upon the invitation of Police Commissioner Eugene C. Hultman of Boston, an experiment was conducted in the hearing room of police headquarters in that city through the medium of RCA Photophone portable recording equipment.

With a cast of characters composed of the Boston police force, members of the bureau of criminal investigation and representatives of the press, a scene depicting the methods customarily pursued immediately following the arrest of a person alleged to have committed a crime was recorded and photographed. Several days later the scene was reproduced by RCA Photophone portable sound reproducing equipment for those who had been present at the recording operations.

Paul Robillard of the engineering department handled the recording operations under the direction of Grover C. Schaefer. H. L. Whitney, district manager of the Installation and Service Department, arranged for the demonstration.

Hall & Connolly Develop New Arc Lamp

Announcement has been made by Hall & Connolly of a new and radically different high intensity projection lamp for current ratings of from 75 to 200 amperes. It is said that the new unit contains a number of striking improvements which will result in better projection and greater ease of operation.

Outline of Sound Recording

By George Dobson †

Having completed in our November issue his discussion of the principles and the mechanism involved in the recording of sound on disc, the author now takes up the subject of film recording. Both the variable density and the variable area methods are described. Consideration is also given to the subject of ground noise reduction.—The Editor.

Part IV

TURNING now to the film recording methods, it is well to note that the details of these methods are largely determined by manner of reproducing sound from the film. This, as is well known to motion picture operators, is to shine a very thin ray of light (approximately .001 inch thick) upon the film and impress whatever part of the ray passes through the film upon a photo-electric cell.

When the sound track on the film varies in density, the amount of light passing through will change. This change will vary the flow of electricity through the photo-electric cell and produce the varying current necssary to control the amplifiers and consequently the current which operates the loud speakers. Another method is to vary the amount of light passing through the film by use of a zigzag pattern. The two types of sound track are shown in Figure 12.

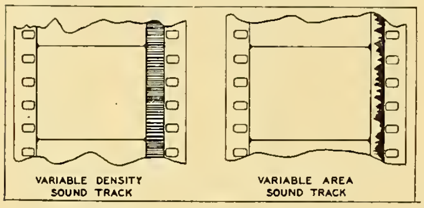


Fig. 12

Variable Density Recording

For many reasons the variable density film has been more widely used than the variable area film. It has certain advantages, such as relative freedom from scratch troubles, but it requires a little more care in the processing of the films. In Figure 13 will be seen a schematic of the arrangement used to produce a variable density sound track on the negative film using a light valve.

To the left there is a lamp, whose light is focused by means of the condensing lens upon a narrow slit. This slit must be so arranged that its final image (produced upon the film by means of the objective lens) is no wider than the ray of light used in reproduction. Practically, owing to halation and similar effects, it is desirable that the image be somewhat narrower in width than this, and, as a matter of practice, it is frequently made only half as wide (that is .0005 inch). The amount of light reaching the negative film is controlled by varying the width of the slit.

In the flashing lamp method, the light valve is replaced by a slit of fixed width and the illumination of the film is varied by changing the current through the lamp and therefore the amount of light it emits.

Owing to the difficulty in getting high illumination from flashing lamps, the negatives produced by the two methods differ appreciably in density; however, this is of no serious importance, since by proper handling in the chemical processing the final results, while not the same in appearance, will both give satisfactory sound.

Details of Light Valve

It may be of interest to look at the light valve itself, or rather at the light valve yoke, which is shown in Figure 14. It will be perceived that there are two narrow ribbons stretched across a small hole in a projection on the yoke. This projection is a pole face, which matches with a corresponding pole face on an electromagnet mounted between the two sets of lenses.

The magnetic circuit of the electromagnet is completed through the frame of the light valve yoke, thus producing a very intense magnetic field between the two pole pieces. Thus, when a current flows through the ribbons, they will tend to move in the magnetic field and are so arranged that they will both move either closer together or further apart, depending on the direction of the current.

The light from a lamp is focused by the condensing lens upon these two ribbons. Therefore, when they move closer together, less light passes between them and when they move further apart more light passes between them. This varying light is again focused by the objective lens so that when it reaches the moving film a thin ray of intense light comes to exact focus on the emulsion. The variations in this light will, of course, affect the emulsion just as the variations of light from different objects affect the ordinary photographic film and there will be produced upon the moving film a pattern of light and dark which looks very much like a ladder with varying sizes of rungs and spaces.

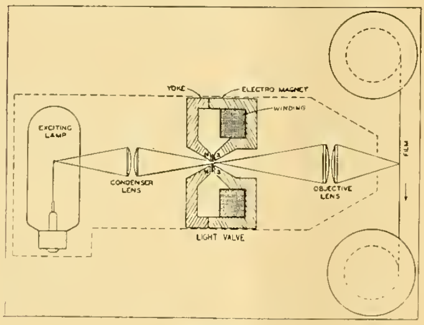


Fig. 13

Reproduction of Record

The negative thus produced is developed and printed upon a positive. The positive, when passed in front of a similar thin ray of light, will vary the amount of light which it transmits to the photo-electric cell so that the photo-electric cell will receive variations in light corresponding exactly to those originally produced by the motions of the ribbons of the light valve.

As already noted, when the flashing lamp is used, an aperture which would correspond to the light valve remains constant in width and the variations in light are obtained by controlling the amount of current in the flashing lamp. In order that there may be produced on the negative an average grayness corresponding to the grayness produced when no current is passing through the light valve, it is necessary that the flashing lamp have an average current which increases and decreases in accordance with the sound waves. However, many difficulties are encountered in getting the same average exposure with the flashing lamp as with the light valve. Therefore, while satisfactory results are obtained, the handling of the two types of negative and two types of positive must be somewhat different.

Variable Area Recording

In producing the variable area film a similar thin ray of light is required which, however, moves to and fro across the sound track. When no sound is being recorded half of the track is exposed and the other half not exposed. When sound is recorded the excursions of the ray will vary with the loudness of the sound being recorded.

Fig. 15 shows diagrammatically how this is done. The moving element which produces the motion of the ray of light is very similar in form to the oscillograph element which has been used for many years in making pictures of relatively high frequency currents. The ribbons or wires of this element are also placed in a strong magnetic field, but when a current passes through them they move in such a way as to rotate the small mirror attached to them.

Since the variable area film requires only black and white, instead of varying shades of grayness, it appears to be simple in handling. However, both the variable area film and the variable density film are seriously affected by the necessity of using a ray of light which, while small, is still of appreciable thickness. If a ray of light of imperceptible thickness could be used and satisfactory exposure obtained, many of the troubles in photographic development and in loss of the higher frequencies would be eliminated.

---

† Commercial Engineering Dept., Electrical Research Products, Inc.

Several rather elaborate papers have been written on the limitations of the two types of recording, but there still appears to be considerable theoretical and practical work to be done.

Noise Reduction

One of the most interesting recent developments in film recording is the so-called "noiseless" recording, which should preferably be known as "noise reduction." Operators are well acquainted with the "hiss" produced by the ordinary film when there is no sound recorded on it. This "hiss" or ground noise is due to small irregularities in the density of the print. If the density of the positive were absolutely uniform there would be no ground noise.

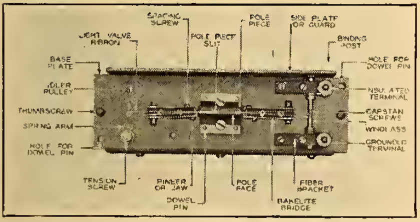


Fig. 14. The Light Valve Yoke

However, up to the present, it has been found impossible in the commercial handling of film to eliminate absolutely these irregularities which apparently are due largely to very fine dirt (dirt being, as usual, defined as matter out of place). Fortunately these irregularities are reduced in their effect as the area of the white part of the film is made smaller and as the density of the sound track is made higher—likewise, the noise is less perceptible when the sound is made louder, since it is masked by the sound itself. On the basis of these facts, noise reduction methods have been evolved for both types of recording.

Application to Variable Density Recording

In the variable density method, the purpose is to have the average density of the positive film as great as practicable at all times—that is, when there is no sound on the film the density of the sound track should be maximum. When the sounds are relatively weak, the average density is somewhat reduced and when the sounds are the loudest which can be recorded the average density becomes the same as it would be were noiseless recording not being used.

In order to do this it is necessary that the density of the negative be just the opposite—that is, during the quiet intervals, the negative sound track will be practically transparent, whereas, during the loud periods the average density will be the same as with noiseless recording. The method of producing this effect is to place upon the light valve ribbons a direct current bias which causes them to come very close together and also superimpose upon this direct current bias a varying and opposing bias which is proportional to the loudness of the sounds being recorded.

The current for the superimposed bias is produced by tapping off a part of the sound current at the bridging bus (Fig. 5, Part 2), amplifying this part and then rectifying it. This rectified part is then superimposed upon the direct current bias in such a way as to reduce that bias, thus increasing the average opening between the ribbons until in the extreme case that opening is the same as it would be were noiseless recording not being used.

Its Application to Variable Area Recording

Two methods of producing noise reduction on variable area film have been used. The first method is by placing upon the oscillograph ribbons a biasing current which acts in a manner similar to that of the light valve ribbons described above. This biasing current moves the average position of the oscillograph mirror close to one edge of the sound track for weak currents and keeps it near the center of the sound track for strong currents.

The other method is to introduce a smaller shutter whose position is varied by means of a similar rectified current in such a manner as to follow closely the envelope of the variable area record, thus blocking out the light from that part of the normally exposed area not penetrated by the valleys in the negative. This blocked-off area becomes in the positive a black area which reduces the amount of clear film in the sound track and correspondingly reduces the amount of background noise.

The background noise on disc records is largely due to the abrasive filler used in the disc record itself. Much work has been done towards finding a new material which while satisfactory in other respects will eliminate this noise. The work has not yet been completely successful, but it appears that when combined with work in other directions it will in the near future be possible to produce discs having the background noise very much reduced.

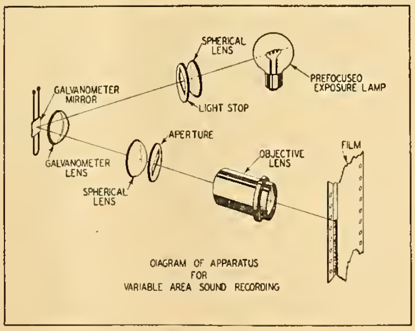


Fig. 15

(To be continued)

BOOK REVIEW

TALKING PICTURES by Bernard Brown, B.Sc. (Eng.). 12 chapters, 302 pages, table of contents and index. Illustrated. Published by Isaac Pitman & Sons, New York and London. Price, $3.00.

PREPARED and printed in England, this attractively bound volume contains, to quote its title page, "A practical and popular account of the principles of construction and operation of the apparatus used in making and showing sound films." To the American reader this subtitle is somewhat misleading, inasmuch as the subject matter is not restricted to the application of sound-on-film methods but also embraces a description of the principles of disc recording and reproduction. A chapter on the subject of theatre acoustics has likewise thoughtfully been included in the volume.

Although the book has manifestly been written primarily for the British projectionist, a good portion of the text and many of the pictures with which it is profusely illustrated being devoted to the application of sound apparatus to foreign projection equipment, the volume contains much of interest for the American reader.

The subject matter is presented in a logical and interesting manner indicating a comprehensive and intimate knowledge of the field and painstaking preparation of the text for publication.

The volume should prove a useful addition to any projectionist's library.

N. Y. and Chicago S. M. P. E. Sections Elect Officers

Officers for both the New York and Chicago Sections of the Society of Motion Picture Engineers have been elected for the ensuing year.

In the New York Section, P. H. Evans of Warner Brothers has been elected Chairman; Donald E. Hyndman, Eastman Kodak Company—Secretary-Treasurer; and the Managers elected are M. C. Batsel, RCA Photophone, and J. L. Spence of the Akeley Camera Company.

For the Chicago Section, the officers are: R. Fawn Mitchell—Chairman; Burton W. Depue—Secretary; and Robert P. Burns and Oscar B. Depue—Governors.

Motor Generator Sets for Arc Circuits

By JOHN H. HERTNER

In the following article Mr. Hertner gives us an account of the purpose, development and advantages of rotating conversion equipment for arc circuits. As the president of the Hertner Electric Company, the author possesses a thorough knowledge of his subject and his words are, therefore, well deserving of the attention of our readers.—THE EDITOR.

THE various changes in the motion picture theatre and in motion picture projection have been closely followed by changes in the auxiliary apparatus used therewith. A review of the industry from its beginning shows an almost continuous growth and change.

Going back to the time when the carbon arc was first used as a source of light it was generally customary to supply it with whatever form of electrical energy that was available, whether A.C. or D.C. If the voltage was too high sufficient ballast was used to bring the arc voltage to about normal and the current to the amount required, if the power was D.C. If A.C. power was supplied a choke coil was generally introduced, cutting the power cost over that required were resistance used.

Advantages of D.C. Recognized

The advantages of direct current were soon recognized and various types of rectifying apparatus were employed where A.C. power was furnished. Thus we are still finding mercury arc rectifiers in service. A considerable number of rotary converters were installed. For small units the vacuum tube rectifier found considerable application. The largest field, however, is that of the motor generator set.

Here again there has been considerable adaptation of the design to fit the conditions of service. The earliest projection rooms, very aptly called "booths," were notoriously small, and since space elsewhere was often not to be had, the designer found a demand for a machine occupying a minimum of floor space. This led to quite a large number of vertical sets being sold while the horizontal units were generally of the close coupled, two-bearing type. There is still a considerable sale for vertical sets.

The most obvious design electrically in a motor generator is to have the output high enough so that the ballast resistance will stabilize the arc in order that it will not require attention too often. The regulation of the unit should be such that it is "flat compound," or that regardless of current load up to a reasonable overload, the voltage is maintained practically constant so that a number of arcs can be run at one time without the one interfering with the other.

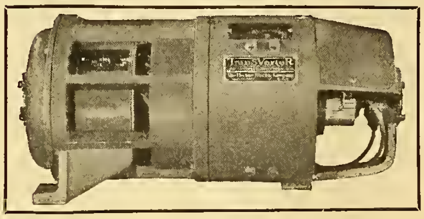


Fig. 1. A Standard Unit

That ballast resistance is necessary when operating off constant voltage is readily apparent when it is remembered that the resistance coefficient of a carbon arc is negative, that is, the greater the current the less the resistance. Were an arc established across a constant voltage and the ballast then shorted out the current would quickly climb to a value which would blow the fuses, destroy the carbons or the leads, or create some other damage, to the point where it would kill itself, not by going out on account of its diminishing value, but by the destruction caused by its excessive value. In other words, without ballast the arc once started would take an amount of current limited only by what the line and the generator could furnish and would endure only as long as the carbons could stand the overload.

Years ago unit rates for electricity were higher than they are today. The theatre owner was keen to save whatever he could on his power bill. Usually he had two projectors and nothing else to feed off his generator. The two projectors naturally took the same number of amperes. This led, about fifteen years ago, to the introduction of the series type of generator which delivers constant current at a predetermined value regardless of arc length and therefore needs no ballast. It thus operates one or two arcs in series, saving the power usually wasted in ballast. Where the arc voltage was, for instance, 55 volts and the generator 85 volts or a ballast drop of 30 in a multiple generator, the energy consumption of the series machine is but two-thirds of that of the multiple type.

The more recent introduction of a multitude of spot lights, stereopticons, dissolvers, etc., requires the production of currents of various amounts simultaneously, besides the horizontal arcs of the present reflector lamps are more sensitive than those of the old "vertical" arcs, hence there has been a decided swing back to the less efficient multiple type of generator.

As the theatre grew the arc amperes in direct current went up successively from 35 to 50 and to 75 amperes on the old type of vertical arcs and when the high intensity lamp came out it raised this to about double, bringing about the need for larger and larger generators.

Then came the so-called "low intensity" reflector lamps with an efficiency so high that the demand for current at the arc went down in some houses as low as 15 amperes. This brought about the building of very small generators, of about 2½ K.W. capacity.

High Current in Demand

The talking picture with its special screen has again reversed the trend and higher current values are again demanded in spite of better light efficiency.

We have then, today, call at the arc of from about 15 amperes to upward of 200 amperes, the range embracing from the low intensity reflector at the lower end to high intensity condenser at the other. The arc voltage of these various sizes and kinds of arcs varies considerably. In a general way this arc voltage varies with the amperes, being greater with higher ampere values. This condition is modified, however, by the type of lamp or rather the kind of carbon. Thus a reflector high intensity burning 65 amperes will have a lower arc voltage than a reflector low intensity with half the amperes.

If the manufacturer of the motor generator were to hold all his product to a standard voltage it might be too

(*Continued on page 39*)

Table 1-A

MULTIPLE ARC TYPE

A.C. Motors—110—220—440 *or* 550 *Volts*—2 *or* 3 *Phase*—60 *Cycle*

Type	*D.C. Amps Continuous*	*D.C. Amps 5 Min. Int.*	*D.C. Volts*	*Type Ballast Rheostats*
MA-20-40	20	40	80	AAA
MA-25-50	25	50	80	AAA
MA-30-60	30	60	80	AAA
MA-40-80	40	80	80	G
MA-60-120	60	120	85	H
MA-80-160	80	160	85	J
MA-100-200	100	200	90	K
MA-125-250	125	250	90	L
MA-150-300	150	300	90	L
MA-200-400	200	400	100	L

Theory and Fundamentals

By W. W. JONES

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Engineering Department of RCA Photophone and has been closely identified with the educational activities of that organization since the time of its inception. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that institution.—THE EDITOR.

Matching the Loudspeaker and the Amplifier

THIS is a continuation of the discussion, contained in the November issue of Motion Picture Projectionist, wherein there were outlined the principles of impedance matching for maximum power and for maximum undistorted power output, as well as the principles governing the selection of a transformer having the proper turns ratio for a given tube plate impedance and a given voice coil impedance. Sample calculations were included in the discussion.

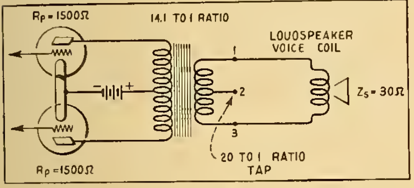


Fig. 4

In the following will be found a discussion of the principles with sample calculations, of the selection of the proper turns ratio transformer for power tubes connected in a push-pull circuit; of multiple stage loudspeaker grouping; of parallel stage loudspeaker connections; of series stage loudspeaker connections; and of series—parallel stage loudspeaker connections.

Push-Pull Tube Circuits

By referring to Figure 4 will be found two power tubes in a push-pull circuit connected to a primary center tapped output transformer, the secondary of which is connected to the voice coil of a loudspeaker. Each tube has a plate impedance of 1500 ohms, and the voice coil of the loudspeaker has an impedance of 30 ohms. Let it be required to find the proper turns ratio for the output transformer for the connections shown in Figure 4.

Two tubes connected in push-pull have a *combined* plate impedance equal to the *sum* of the plate impedance of the two tubes. In this case, the *combined* plate impedance is 1500 ohms *plus* 1500 ohms or 3000 ohms.

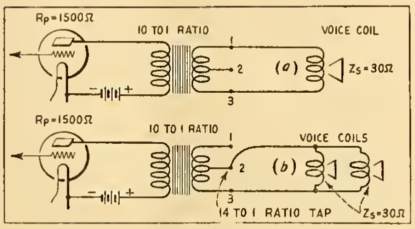


Fig. 5

From previous discussion it has been pointed out that for maximum *undistorted* power output a tube must operate into a load impedance equal to *two* times its plate impedance. For a push-pull circuit the tubes must operate into a load impedance equal to *two* times the *combined* impedance, or in this case the load impedance equals two times 3000 ohms or 6000 ohms.

Since the voice coil of the loudspeaker has an impedance (Zs) of 30 ohms, it is necessary to select an output transformer having the proper turns ratio which will cause the 30 ohm voice coil to present an *equivalent* load impedance (Zp) of 6000 ohms.

Calculating the proper turns ratio

$$N = \sqrt{\frac{Zp}{Zs}} = \sqrt{\frac{6000}{30}} = \sqrt{200} = 14.1$$

The secondary of the transformer in Figure 4 is tapped so that two speakers may be connected in parallel and then operated from terminals 2 and 3. Reference to the use of this tap will be made later in this discussion.

Multiple Speaker Grouping

Often in sound motion picture work it is found that a single stage loudspeaker does not produce adequate sound in all portions of the theatre or auditorium. If the auditorium is wide and the stage loudspeaker is directed down its center of volume, the front right and left hand group of seats in the orchestra and/or balcony will in all probability have inadequate volume. Likewise if the auditorium is high the rear balcony seats and/or the front orchestra seats will suffer in volume.

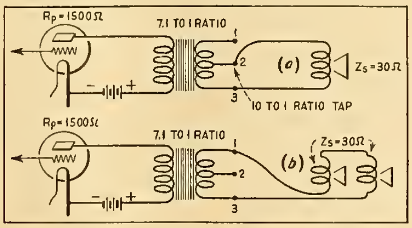


Fig. 6

Inadequate coverage with a single stage loudspeaker is occasioned by the common use of the loudspeaker horn, or directional loudspeaker baffle, which horn or directional baffle directs the sound beam in the direction in which it is pointed. In order to effect adequate coverage in a relatively wide auditorium it is necessary and common practice to install two stage loudspeakers arranged in a horizontal plane, and directed so as to distribute the sound uniformly and yet secure adequate sound coverage for the front, right and left hand group of seats referred to above. In the case of an auditorium which is relatively high two stage loudspeakers may be used and arranged one above the other, and directed for uniform distribution and proper coverage of the rear balcony and front orchestra seats referred to above. However, in the case of a large auditorium where it is both too wide and too high for a single loudspeaker it becomes necessary to use four loudspeakers arranged in a bank. The bank of four speakers usually is arranged and so directed that the lower group of two speakers covers the orchestra seats, and the upper group of two speakers covers the balcony seats. When either the lower group or upper group is adjusted, the speakers are directed so as to provide adequate sound for the side seats in both the balcony and the auditorium. Then the upper and lower groups are adjusted as a group so as to secure uniform distribution throughout the auditorium and adequate coverage of the rear balcony seats and the front orchestra seats.

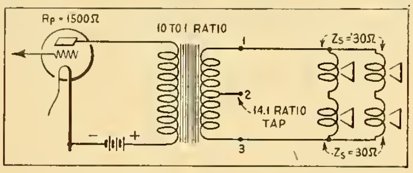


Fig. 7

Parallel Loudspeaker Connections

From the foregoing discussion on multiple speaker grouping it can be seen that it is often desirable to provide means of operating from one amplifier two or more loudspeakers. This may be accomplished by providing an extra tap on the secondary of the output transformer. The location of the tap in the winding will, of course, be determined by the circuit used in connecting the loud-

(*Continued on page* 34)

Patents:

A series of instructive and interesting articles on how patents are obtained and sold.

By RAY B. WHITMAN

NOTE: *In this series of articles Mr. Ray B. Whitman, practicing patent attorney of New York City, explains in understandable non-technical language, just what a patent is, how one is secured and how it may be sold. In addition, Mr. Whitman offers to the readers of this magazine personal advice without obligation on any subject connected with patents, trademarks, designs, or copyrights. All inquiries should be addressed to Mr. Whitman in care of this magazine.*—EDITOR.

Foreign Patents

SOME time before the United States patent application is ready to issue, and within a year of its date of filing, and preferably immediately after the first office action is received, the inventor should give careful consideration to the question of protecting his invention abroad. For, unless this is done in time, he is prevented from later getting valid patent protection in most of the important foreign countries.

This practice of taking out foreign patents is often seriously neglected, to the inventor's loss, and again often overdone, to his needless expense.

A Practical Illustration

As illustrative of the former practice may be cited the following reported incident:

When the world's greatest inventor, Thomas A. Edison, somewhat late as usual, got around to taking out a patent on the moving picture machine perfected in his laboratories, he was advised to apply also for foreign patents. But he was cautious.

"How much will it cost?" he asked.

"Oh, about $150."

"It isn't worth it," concluded the inventor.

That was many years ago. One wonders what Edison thought when a few weeks ago, American receipts from motion picture royalties abroad were given as "at least $300,000,000 for the last six years." During one recent year alone these foreign royalties piled up to $75,000,000.

On the other hand, as illustrative of the latter practice, it became so common years ago for certain advertising members of the patent profession to advise their clients to file foreign patent applications where the hope of a return was negligible that the Patent Office printed in one of their official bulletins, distributed free to the public, the following warning to inventors against filing foreign applications without due consideration of their probable value:

"In general, an inventor should be satisfied that he can make a profit from foreign patents before applying for them.

"Before arranging for foreign applications, it is generally desirable to wait an official statement by the United States Patent Office that a United States patent will probably be granted, since in most foreign countries an application for patent may be filed within 12 months of the date of filing in the United States with the same effect as if filed on the day the application is filed in the United States.

"In most foreign countries there is a requirement that unless actual operation under the patent begins in the country issuing the patent within a predetermined period and is thereafter kept up, the patent will become void or be subject to the grant of compulsory license. That is to say, other persons may apply for a license to operate under the patent to be granted on terms to be determined by the government or a court of the country issuing the patent.

"In most foreign countries in addition to the original patent fees, there are taxes paid annually or from time to time, increasing in amount, so that a foreign patent frequently becomes a heavy financial burden."

Advice to Inventors

The author's advice to inventors, and which is based upon what large corporations have learned is the most profitable policy regarding the filing of foreign patents, is this:

It is usually advisable to take out a patent in Canada, since their market is practically a continuation of our own; and although Canada has only eight or nine million people, against our one hundred and eighteen million, their patent is almost a copy of ours, and so costs less to get; and thereafter, there are no complications, such as annuities to keep it in force throughout, its term, as there are with most other foreign patents.

The other countries which should receive consideration, in most cases, are the following, perhaps in the order of their usual importance: Great Britain, Germany, France, Italy, Japan, Mexico, Brazil, Argentine.

Of course, all depends upon the nature of the invention and its probable market. For instance, due to the great development of electrical power in the Scandinavian countries, electrical inventions often find a ready market there. And the author once came across a peculiar case where a patent was all-important in the remote little country of Iceland.

There are now over 50 foreign countries having patent laws which enable the inventor to protect his invention. To take out protection in all of these is to take out what is popularly known as a "world patent," which is thus merely a series of independent patents, instead of just one, as is commonly supposed.

Such complete patenting is usually inadvisable, although sometimes it happens that the mere filing of many foreign applications actually aids an inventor in raising capital through a corporation, since he appears to be getting a wider and more valuable patent monopoly, and can therefore better trade with the corporation for a more equitable stock interest. Thus, it becomes a matter of business policy.

Of all the foreign countries, Germany is about the only one besides our own which grants the inventor a patent containing, *in itself*, any substantial protection. For it, like a United States patent, is granted only after a thorough search in the prior art to determine its novelty. Such searches are either entirely absent in the other countries or are only nominal in character, so that the patents are more in the nature of registrations, similar to our trade marks. For this reason, the patents of such countries are not taken so seriously until after they have been through the courts and their novelty and scope determined.

Sometimes of Great Value

But there are often instances where patent protection abroad is of great value, even exceeding its value at home. In the absence of such special considerations, however, the inventor should be quite conservative in spending money to take out many foreign patents. He would better apply it to a more thorough patenting or marketing here, as by the filing of patents on improvements, or in employing expert assistance to exploit better the sale of his rights.

Enough has been told to convince the inventor that he should here again follow the advice of some reputable attorney, who has had experience in the filing of foreign cases, and preferably also in their marketing.

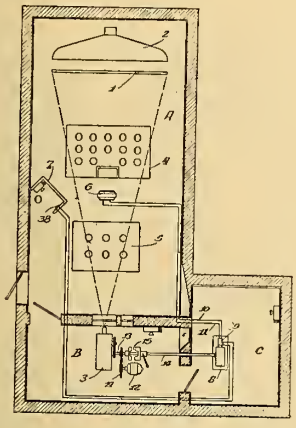
Most foreign patents are filed through a small group of "International Patent Attorneys," who carry on a wholesale business abroad, by correspondence, for all the other patent attorneys. They have associate attorneys residing in the various foreign capitals, who actually represent the inventor's interests abroad, being aided by the international attorney, who also understands foreign law and procedure. The inventor can either have his foreign patents filed through his own attorney, who will then transmit them to his international attorney, or he can, in some instances, deal direct with the international attorney himself.

(*Continued on page* 36)

RECENT PATENTS

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 230 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine, and enclosing fifteen cents to cover costs.

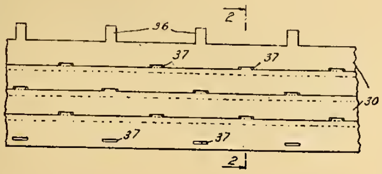
1,828,444. METHOD OF AND APPARATUS FOR RECORDING SOUND ON MOTION PICTURE FILMS. WILLIAM ROM, Berwyn, Ill. Filed Nov. 15, 1928. Serial No. 319,515. 3 Claims. (Cl. 88—16.2.)



1. A method of recording sound on a moving picture film which consists in utilizing two positive films of the same picture and projecting one positive film onto a screen for guidance in applying sound to a negative film made from the other positive film of the same picture, driving said other positive of said film in synchronism with the projected film, masking a portion of said other positive to thereby provide an area for the sound record, driving a negative film in synchronism and printing relation with said other positive and with the sound area of said other positive masked as to said negative, and simultaneously recording sound on the sound area of said new negative, the sound record being applied to the sound area of said negative in accordance with the projected positive of the same picture.

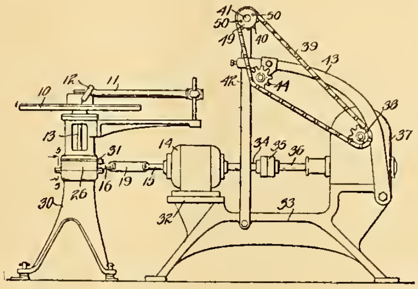
▼

1,828,749. MOTION PICTURE SCREEN. ALBERT L. RAVEN, Mount Vernon, N. Y. Filed July 11, 1930. Serial No. 467,149. 10 Claims. (CL. 88—24.)



2. A screen for the projection of pictures accompanied by sound comprising a plurality of wavy horizontal strips arranged with the upper edge of each strip overlapping the lower edge of the next higher strip, and the peaks of the waves in said strips opposite one another, and means for securing the strips to one another at said peaks whereby numerous sound passages are provided between said points of attachment extending upwardly from the rear toward the front of the screen.

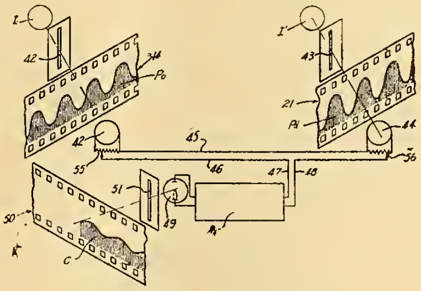
1,827,947. SYNCHRONIZING TALKING MOTION PICTURE MACHINES. WILLIAM R. MOORE, JR., Hagerstown, Md., assignor to Deca Disc Phonograph Company, Waynesboro, Pa., a Corporation of Pennsylvania. Filed Apr. 29, 1929. Serial No. 359,014. 3 Claims. (Cl. 88—16-2.)



1. Means operably connected to a talking machine and a picture projecting machine to drive them in synchronism comprising a motor, a motor shaft, a worm on said shaft, a flexible connection in said shaft, a record table, a shaft supporting said table, a worm gear on said shaft, and means for adjusting the said worm toward the said worm gear for taking up lost motion between the shaft of the motor and the shaft of the record table, substantially as set forth.

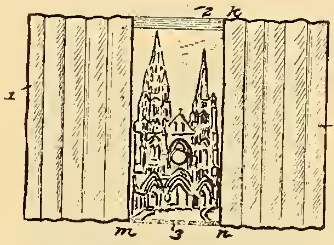
▼

1,828,941. SYSTEM FOR CORRECTING SOUND RECORDS. ROY J. POMEROY, Los Angeles, Calif. Filed May 22, 1928. Serial No. 279,790. Renewed Mar. 13, 1931. 6 Claims. (CL. 179-100.3).



1. The method of modifying sound records that includes, making an original record of audible sound, audibly reproducing the sound with the distortions of reproduction, making a distortion record of the distorted sound as so reproduced, synchronously producing electrical sound currents from the original and the distortion records, differentially combining the sound currents so obtained in such a manner that the sound currents are neutralized except for a distortion-representing current, making a correction record of the distortion-representing current, and making a distortion-corrected record by modifying the original record with the correction record in such a manner as to alter the original record by the amount of and in a sense opposite to the distortions introduced in reproduction.

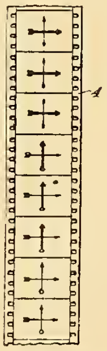
1,829,633. PROCESS FOR TAKING OR PROJECTING PHOTOGRAPHIC OR CINEMATOGRAPHIC PANORAMIC VIEWS OR VIEWS EXTENDING IN HEIGHT. HENRI CHRETIEN, St. Cloud, France, assignor to Societe Anonyme Francaise dite Societe Technique d'Optique et de Photographie (S. T. O. P.), St. Ouen, France. Filed Jan. 9, 1928. Serial No. 245,558, and in France Apr. 29, 1927. 3 Claims. (Cl. 88—16.)



3. The improvement in the art of projected pictures which comprises first determining what portion of a view other than any having the relative dimensions of the image space of the film is desirable for reproduction, then photographing such portion while optically compressing the image in one dimension sufficiently to make it correspond to the relative dimensions of the image space, and thereafter projecting the image while optically restoring the image in said dimension to give it the dimensions of said portion of the view, whereby projected pictures may be given the dimensions best suited for framing the view without regard to the image spaces on the film.

▼

1,829,634. TAKING AND PROJECTION OF MOTION PICTURES AND FILMS THEREFOR. HENRI CHRETIEN, St. Cloud, France. Filed Jan. 28, 1929, Serial No. 335,564, and in France Apr. 29, 1927. 4 Claims. (Cl. 88—19.5.)



1. A motion picture film having thereon a plurality of series of images, each image being of the same area, the images of one or more of said series all having proportions normal with those of the object and the images of another or others of said series all being optically compressed in one given direction whereby by projecting the film on the screen with ordinary enlargement of the images of some of the series and with suitable differential enlargement of images of the other series, pictures in natural proportions but of different sizes and shapes best suited to the nature of the view may be made to appear upon the screen.

New Equipment and Appliances

Television-Talkiola

A NEW Television Talkiola machine, which is claimed as being the most complete home entertainment device ever produced, was exhibited recently.

It is made especially for home use and incorporates within the one machine six different types of entertainment. These include television with synchronized sound, talking motion pictures, silent pictures, electric phonograph, short wave radio and standard broadcast radio.

All mechanisms are concealed within a handsome walnut cabinet, not very much larger than the consoles used to house the better types of radio receivers. The Television-Talkiola cabinet is extremely attractive in design and will help to adorn the most luxuriously appointed home.

The Television Equipment

The television unit for viewing the radio-transmitted picture is located at the top of the cabinet. It includes a 1/15th horsepower synchronous motor which turns a horizontal metal plate. The plate supports a narrow strip of thin steel perforated with a number of square holes. The plate also supports a neon lamp.

There is an adjustable lens at the front of the cabinet, set within a specially designed visor. The adjustment permits the television picture to be focused as required. The 6"x8" picture is very clear and the special visor prevents extraneous light from dimming the image. Below the visor are knobs for turning the current "on" or "off" and for keeping the picture in frame.

Other Details

Below the television unit is the phonograph with electrically operated turntable and electromagnetic pickup. Underneath this is the motion picture projector, designed for 16 millimeter film. A 1/20th horsepower electric motor is used to drive both the phonograph turntable and the motion picture projector.

Perfect picture reproduction is attained on a transparent screen which unfolds from the front of the cabinet, allowing a large number of people to view the picture. A standard radio tuner of ultra-modern design occupies the space below the projector. A separate and complete short wave receiver for tuning in television signals is located within the cabinet, with controls and tuning dial on the right side of the cabinet.

The Amplifier

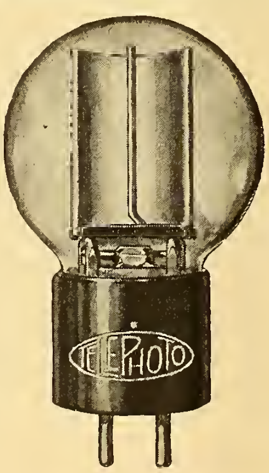
The cabinet also contains a powerful two-stage amplifier, with a 124 screen grid tube in the first stage directly coupled to two 145 power tubes arranged in push-pull in the output stage. The dynamic reproducer is located at the lower left portion of the cabinet. This speaker is of the highest quality obtainable. In the lower right-hand portion of the cabinet there is a large compartment for films and records. The dynamic speaker is removable in order that the sound may be projected from any portion of the room, as desired.

It is a product of the Talkiola Corporation of New York.

New Telephoto Cell

According to a recent announcement of the Telephoto & Television Corporation of New York, its research group has recently developed a new photoelectric cell of great sensitivity. The new tube is of the caesium argon type and carries a six months' guarantee, it is stated in the company's announcement.

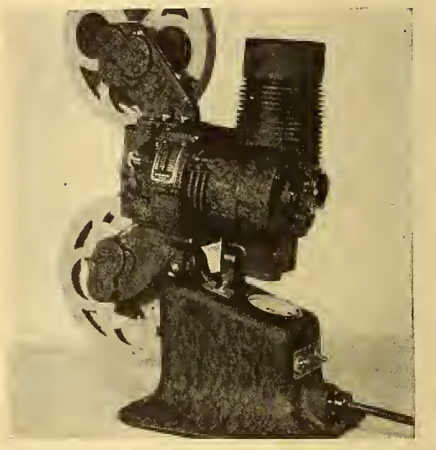
The cell is manufactured in three sizes and is fitted with the standard four-prong base. The polarizing voltage range is from 22½ to 90. With 90 volts on the plate, the output of the cell is rated at approximately 50 micro-amperes per lumen.



Mr. Herschman, sales manager for the company, states that the firm is doing an excellent business not only in photocells, but also in television products such as crater tubes and cathode ray tubes.

New Filmo Projector

A NEW Filmo projector, the Model J, is announced by Bell & Howell. With a picture brilliance asserted to be practically 30% greater than that afforded by even the Filmo 57-GG, it is hailed by its makers as marking "the most outstanding advance in the history of personal movie projection." Life-size movies of theatre quality, it is stated, are easily projected by it in the home, classroom, or auditorium.



For months, we are informed, engineers have been engaged in perfecting this new projector. Not only are superlative performance and ease of operation claimed for it, but it has a handsome, luxurious appearance and sets a high mark in beauty of line and finish. The Model J is low-built with a large base designed to afford desirable stability, as well as making for beautiful proportions.

The new projector is entirely gear-driven and hence dispenses with all belts and chains. The gears are fully encased. This is asserted to be the first fully gear-driven 16 mm. projector.

The notable increase in picture brilliance, which is said to have been demonstrated in exhaustive tests, has been secured by an improved 375 watt lamp, a new Cook 2-inch F 1.5 projection lens, improved condenser, a large reflector, and a refined reflector adjustment. And there is a novel light trap whose purpose is to prevent the escape of stray illumination.

The above are only a few of the new and distinctive features of this new projector which, the manufacturers state, is bound to be a sensation in the 16 mm. world.

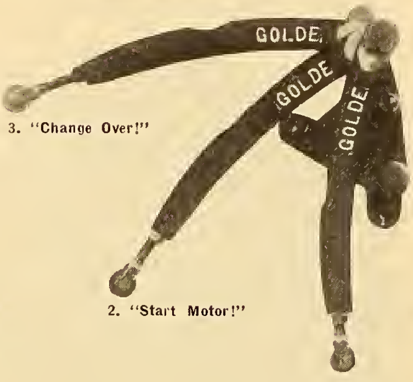
The How and Why of Lenses

(*Continued from page* 13)

Point F., Figure 3-G, is called the principal focus of the lens and is measured by the radius of the curvature of the lens. Now, suppose we place a source of light L, which hereinafter we shall call a radiant, at the principal focus F. Light rays from this point and incident on the surface of the lens will be refracted and upon emerging they will take parallel paths as shown. This, you will note, is just the reverse of what happened in Figure 3-F.

Figure 3-H shows that if a radiant L is placed to the left of the principal focus of a converging lens the rays upon emerging from the lens will be bent downward and will meet at a point L1 beyond the principal focus F1 on the opposite side of the lens. If the radiant is placed at L1 the rays will converge at point L. This pair of points at which the rays converge on both sides of the lens is called the "conjugate foci" and are so related that L1 is an image of L, or if L1 is the radiant then L is the image of L1.

If the radiant L in Figure 3-I is placed between the principal focus F and the lens we will find that the emerging rays will diverge, spread out, and never meet in a focus on that side of the lens. However, if these divergent rays are traced backward, as shown by the dotted lines, they will meet at F. Our concern with lenses, therefore, is to know that with them we are able to collect rays of light and direct them according to our requirements. With the knowledge of how light is affected, or acted upon, in passing through various types of lenses, we are better able to design picture and sound head optical systems, and in the case of the projectionist, better able to adjust and to service the equipment intelligently.


GOLDE
GOLDE
GOLDE
3. "Change Over!"
2. "Start Motor!"
1. "Get Ready!"

GOLDE
Three-Alarm

***Says:* 1. "Get Ready!"**
2. "Start Motor!"
3. "Change Over!"

You can't help but give a smooth, unbroken show with this marvelous timing device. Gives three distinct signals. You can't miss them. You can't mistake them. Good shows help the box office. Plenty of warning relieves you of worry. You don't have to watch the screen at all: a wink or sneeze can't make you miss a cue. Your machine is at full speed when wanted—no chance for slow pickup to spoil the show.

Installed in five minutes. Adjusted in five more. Never needs further attention. Never fails. Nothing to get out of order. Made of steel, bronze, and duralumin finished in black crackle lacquer, outlasts the projection machine. Pays for itself in convenience in one performance. Pays for itself at the box office in a month. Write for illustrated folder with full description and moderate price.

GOLDE MANUFACTURING COMPANY
2013 LeMoyne Street, Chicago, Ill.

for
TRUE and LIFELIKE REPRODUCTION
use "TELEPHOTO" Photoelectric Cells

The Caesium-Argon Cell of QUALITY. End your cell worries by adopting "TELEPHOTO" as your standard equipment.

WRITE for Pamphlet No. 5 and prices.

Telephoto & Television Corp.
133-135 West 19th Street, New York City

Sound Head Optical Systems

(*Continued from page* 17)

second) of the recorded sound. Hence to obtain the length of sound track occupied by one cycle (or one complete vibration) of the recorded sound the procedure would be to divide the length of track passing under the beam in one second by the frequency of the recorded sound. Omitting the actual work of division the length of track required for one complete cycle of each of the following frequencies is:

100 cycles	....0.180 inch
1000 cycles	....0.018 "
10000 cycles	....0.0018 "
18000 cycles	....0.001 "

Remembering that the only condition under which sound is actually reproduced is that obtaining when the light falling upon the photocell varies, it may be seen easily that with a light beam falling on the sound track having a width of 0.001 inch and with a recording on that sound track of which each cycle (or complete vibration) occupies a space of 0.001 inch there will be no variation of light falling upon the photocell as the film recording passes under the scanning beam and hence no sound.

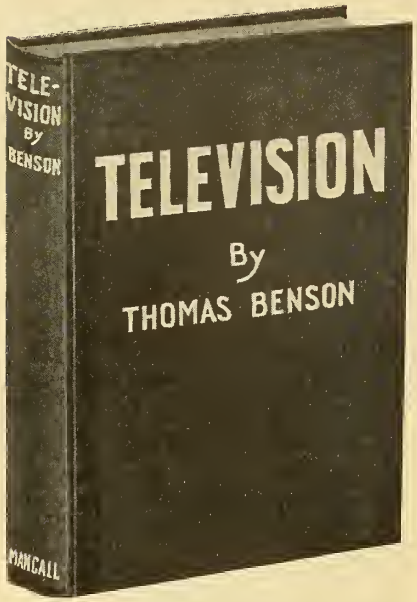
Similarly, it may be proved both by actual experiment and mathematically that the variation of light falling upon the photocell increases as the disparity between the slit width and the length of track occupied by one cycle of the sound increases. The point at which computation shows that no response will be obtained from a given slit and lens assembly is called the theoretical point of cut-off of the combination to distinguish it from the point of practical cut-off of the combination. The practical cut-off of any such assembly is roughly one-half of the theoretical cut-off and represents the point at which the response of the slit and lens assembly begins to dwindle below the point of practical usage.

Its Importance to Reproduction

Slit width, or, more properly, the width of the light beam at the film, is of the greatest importance in the satisfactory reproduction of sound. Effectively, a slit is widened when it is rotated to any position other than that in which it is horizontal and parallel to the plane of the film. That this is true may be seen from consideration of the effect of rotating the entire lens barrel.

If such rotation be done to such a degree that the light beam is in a vertical position the extreme of this effect is observed. The light beam is now vertical and extends approximately 0.084 inch instead of 0.001 inch as before. Rotating the lens barrel from this position 45 degrees towards its normal position also rotates the light beam and the width

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today. It is a book both for the interested layman and for the craftsman who will shortly depend on television operation for his livelihood. It has been written especially for the motion picture projectionist who will unquestionably operate television in the theatre as he now does sound equipment. The serious projectionist will get a copy at once.

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

TELEVISION
By Benson $2.00

SEND THIS COUPON TODAY
Mancall Publishing Corp.,
7 West 44th Street, New York City
Enclosed find money order for $2.00.
Please send me Benson's Television.

Name ....
Address ....
City and State ....
Theatre ....

of the light beam is, effectively, reduced from the maximum obtained with the slit in the vertical position. As the slit is rotated back to its normal setting the width of the light beam grows narrower until, in its correct position, the light beam once more is but 0.001 inch wide. As the lens barrel was being rotated until the light beam was perpendicular, the cut-off of the slit and lens assembly was being reduced to lower and lower frequencies and the output of the reproducing system suffered in quality accordingly.

Standardization of Picture Apertures

(*Continued from page* 20)

technical representatives was called to hear the report of the subcommittee and to decide between alternatives presented for several items of the specifications. The following studios were represented: Paramount-Publix, Universal, Metro-Goldwyn-Mayer, Fox, RKO, Technicolor and Consolidated Film Industries.

The specifications were approved and it was urged that they be submitted to the executives of the studios with a recommendation that the standardization be adopted.

Technicolor Moves from Boston to Hollywood

Technicolor has transferred all activities from Boston to its large Hollywood laboratories, it has been announced by Dr. Herbert T. Kalmus, President and General Manager of the Technicolor Corporation. Heretofore most of the Technicolor release prints have been manufactured in Boston.

This move, which consolidates all Technicolor work — photography, printing of rushes and release prints, as well as research—in the capital of the motion picture industry, means an economy of time in production that is important to the industry, Dr. Kalmus pointed out. Producers have expressed real satisfaction over the change, which is in keeping with the general policy of the industry, as it has developed in the last few years, to turn out release prints in Hollywood.

Some forty Technicolor executives and technical men from the Boston plant already have arrived in Hollywood to augment the West Coast personnel.

In addition to saving considerable time in the delivery of negatives to the laboratory the new arrangement will enable directors and other production executives to cooperate more closely with Technicolor in inspecting prints before they leave the plant.

Technicolor opened its Hollywood laboratory in May, 1930.

Theory and Fundamentals

(*Continued from page* 29)

speakers to the transformer.

Diagram (a) Figure 5 shows a 30 ohm voice coil connected to terminals 1 and 3 of the transformer. The tube has a plate impedance of 1500 ohms. Since the *equivalent* load impedance (Zp) must equal 3000 ohms, the turns ratio

$$N = \sqrt{\frac{3000}{30}} = \sqrt{100} = 10$$

Diagram (b) Figure 5 shows the same tube and transformer, but two loudspeakers in parallel are shown connected to terminals 2 and 3. Let it be required to find the turns ratio of the transformer for this connection in order to locate the position of the secondary tapped terminal 2.

Since the *two* speakers are connected in *parallel* the *total* voice coil impedance is equal to 30 divided by *two* or 15 ohms. Having a *total* voice coil impedance (Zs) of 15 ohms, the turns ratio of the primary winding to terminals 2 and 3 of the secondary winding equals

$$N = \sqrt{\frac{3000}{15}} = \sqrt{200} = 14.1$$

It is to be observed here that the above principles can be applied to the operation of push-pull circuits. Referring to Figure 4 the secondary of the transformer is tapped for two speakers operating in parallel in which case the turns ratio of the primary winding to terminals 2 and 3 of the secondary winding is 20 to 1. The calculations for determining this ratio will be left to the reader.

Series Loudspeaker Connections

Figure 6 shows the secondary terminal arrangement of the output transformer when it is desired to use either one speaker or to use two speakers connected in *series.* Diagram (a) of this figure shows one loudspeaker connected to terminals 2 and 3 of the secondary winding. Diagram (b) shows two speakers in *series* connected across the entire secondary winding (terminals 1 and 3).

The turns ratio of 7.1 to 1 in the case of diagram (b) Figure 6 is determined as follows: The tube plate impedance is 1500 ohms and the *equivalent* load impedance (Zp) should be 3000 ohms. The *total* voice coil impedance (Zs) of the two speakers in series is equal to the *sum* of the voice coil impedance of the two speakers or 30 plus 30 or 60 ohms.

The turns ratio then is

$$N = \sqrt{\frac{3000}{60}} = \sqrt{50} = 7.1$$

It is to be noted that for one loudspeaker, diagram (a) Figure 6, the turns ratio of the primary winding to the tapped terminals of the secondary winding is 10 to 1, and this ratio is the same as for the case where the speaker voice coil is connected to terminals 1 and 3 in diagram (a) Figure 5. Since the turns ratio is the same, the operation of the speaker would be the same. However, the transformer in Figure 6 provides an extra tap (terminal 1) so that two speaker voice coils may be connected in series, whereas, the transformer in Figure 5 provides an extra tap (terminal 2) so that two speaker voice coils may be connected in parallel.

The transformers in Figure 5 and Figure 6 are not identical and may not be interchanged in use except where one speaker is used, and in this case connections to the individual transformers must be made as shown in diagram (a) of each figure. That is, the transformer of Figure 5 cannot be used for series voice coil connections, and the transformer of Figure 6 cannot be used for parallel voice coil connections.

From an electrical viewpoint either the series or the parallel arrangement of loudspeakers may be used. The following paragraphs will point out how either the transformer of Figure 5 or Figure 6 may be used for four speaker operation.

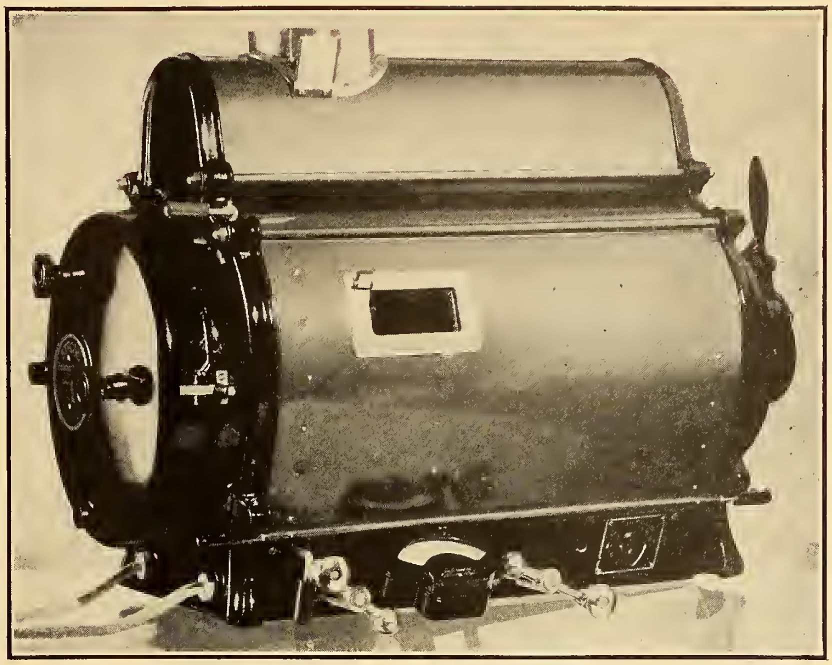
Series—Parallel Connections

In those cases where it is found desirable to use four loudspeakers they may be connected in a series—parallel circuit arrangement as shown in Figure 7. The group of loudspeakers may then be connected across terminals 1 and 3 as shown in the figure.

Since a series—parallel circuit arrangement is used the *total* voice coil impedance may be determined as follows: There are two parallel groups of voice coils; each group having two voice coils connected in series. Each group has an impedance of 30 plus 30 or 60 ohms. Since the two 60 ohm groups are connected in parallel the *total* voice coil impedance then equals 60 ohms divided by 2 or 30 ohms.

Since the *total* voice coil impedance of the four speakers connected in series—parallel is 30 ohms, and since the impedance of one voice coil is also 30 ohms, a transformer which is selected for one speaker operation is also suitable for four speaker operation. By referring to Figure 5 the transformer turns ratio for one speaker is 10 to 1. This same transformer ratio may be used for four speakers. Also since this transformer is tapped at a turns ratio of 14.1 to 1 (terminals 2 and 3) it may be used for two speakers having their voice coils connected in parallel as shown in diagram (b) Figure 5.

It may be pointed out here that the transformer of Figure 6 is tapped (terminals 2 and 3) to give a turns



"—the answer to your projection problems—"

H. H. Strong.

For Sale By Independent Supply Dealers

The Strong Electric Corporation

2501 Lagrange St., Toledo, Ohio

Export Offices: 44 Whitehall Street, New York, N. Y.

Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film

Permanent Gauge No Adjusting

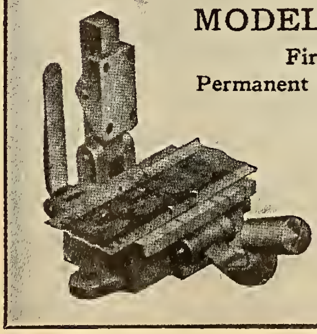
FOR THEATRES, EXCHANGES LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.

816-826 East 140th St., NEW YORK, N. Y.

For sale by all Supply Dealers



STILL PREFERRED

Above All Others

MORE Miehling books have been sold to projectionists than any other . . . There have been others since Miehling's book was brought out . . . and some at a lower price . . . but Miehling's still remains as the *only book written by a projectionist for projectionists* . . . . That it why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of *all* sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.
519 pages . . . completely indexed

THIRTY-ONE chapters, each covering a phase of sound equipment operation, are thoroughly indexed in the back of the book, affording the projectionist full means of reference in case of trouble. The whole set-up of the book has been designed for leisurely reading or for quick use in a breakdown emergency.

ONE hundred and thirty-seven illustrations: diagrams, schematic drawings and photographs are scattered through the book, adjacent to connecting text. Continuity of text and picture is thus preserved throughout. A perfect book for projectionists.

Price $4.00, We Pay Postage

Mancall Publishing Corp.,
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $4.00.

Name ....

Address ....

City and State....................................

Position ....

Theatre ....

ratio of 10 to 1. This transformer may be used for the series—parallel group of four speakers if the group is connected to terminals 2 and 3. However, if this transformer is used it must be pointed out that for two speaker operation the voice coils must be connected in series as shown in diagram (b) of Figure 6.

If the series—parallel group of four speakers are to be operated from a push-pull power circuit as shown in Figure 4 then the group of four speakers may be connected to terminals 1 and 3 of the 14 to 1 ratio transformer. Likewise, if two speakers are to be operated in parallel they are to be operated across terminals 2 and 3.

Nearing the Television Goal Line

(*Continued from page* 22)

The question is constantly raised, of course, as to how imminent television really is as a widespread reality for the home and the theatre. There could be no acceptance of television, of course, as long as television was confined to the laboratories. Today, however, there are broadcasting stations operating on regular schedules and their activities are gaining increasing space in the columns of the newspapers. The radio commission is besieged by additional applications for television broadcasting licenses. Additional companies are constantly going into the business of manufacturing, but, obviously, television has not the proper impetus and still is lagging behind.

If the time comes when commercial instead of experimental licenses are granted to television stations television will receive a very substantial boost. The field, of course, is in something of a vicious circle. The real inducement to prospective builders of transmitting stations is the existence of a large "seeing" public but, similarly, the most forceful excuse for the purchase of a television set is the existence of proper broadcasting facilities. Any added impetus at this time must come from an intensive development of the broadcasting and manufacturing ends of the scheme.

Public Interest Increasing

There is no question but that television is causing ever-wider interest. Thousands of people saw the demonstrations of Sanabria television in New York, and during the next few months many more thousands all over the country will be introduced to television.

It is only through the proper presentation of television that the future of the art can be expedited. George Gruskin, president of the Sanabria organization, has arranged with William Morris, the veteran showman, to supervise the presentation of the television units in theatres. An organization has been developed to develop the various presentation aspects of television. Questions of makeup, television types, studio technique and others are being carefully considered.

The motion picture, however, will continue to play a formidable part in the evolution of television. It will provide for some time to come the most comprehensive and adequate subject for television. The development of visual broadcasting may be slow for the time being but its ultimate development is as inevitable as the continuance of talking pictures, and between these two fields there will be a kinship which will finally develop television to its highest points.

Patents

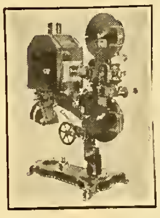
(*Continued from page* 30)

Every patented article should appear with the statutory marking as required by law. This marking includes the word "Patent," followed by the number of each issued patent.

If this patent marking is not followed, the patent does not become invalidated, as some think, but a very valuable right is lost. For, should the patent later become infringed, its owner cannot collect profits and damages for any infringement prior to the date that the infringer was notified of the infringement and requested to cease; whereas, had the article been properly marked, as above, no other form of notice to the infringer is necessary, and for any infringement which can later be shown to have taken place prior to the time that it was discovered and the suit brought, the profits and damages covering that back period, limited only by the Statute of Limitations, may be collected by the owner of the patent.

This right is thus frequently of great value, and suggests the desirability of always marking every patented article with its patent numbers. Such marking, furthermore, is usually very good advertising, since it gives a dignity and sense of value

Sell Portable Talkie Sound-on-Film to Theatres, Schools, Churches Clubs, etc.



Write for manufacturers' prices on Soundheads, Photo-cells, Optical Systems, Rectifiers, Amplifiers, Horns, Faders, Synchronous Motors, Projectors, Lamphouses, Screens, Microphones, etc.

S. O. S. Corporation
Dept. M. P., 1600 Broadway
New York City
Cable Address, "SOSOUND"

to the article so marked. It also, of course, appreciably reduces infringement troubles.

Infringement Searches

The following advice is of particular value to manufacturers and investors of patented inventions.

Anyone who seeks to profit through the manufacture and sale of a patented invention, whether that one be the inventor himself, or the assignee or licensee of his rights, must first determine if such manufacture and sale would infringe the prior patent rights of others. For, as previously explained, the granting of the patent itself gives no assurance of a right to its use. It is most important, therefore, before spending time and money to market a patent, to have a good patent attorney make a thorough "infringement search."

Infringement and Patentability Search

An *infringement* search differs from a *patentability* search in that, in addition to finding all patents containing the disclosure of a similar invention, in whole or in part, each and every one of the claims of all such patents must be carefully "read" on every part of the new invention to determine which of the claims, if any, would be infringed.

Also, while a patentability search should include foreign patents as well as domestic and foreign publications, including patents, magazine articles and books, an infringement search, being usually only concerned with the right to use the invention in the United States, includes only a study of the unexpired United States patents, and not the older U. S. or any foreign patents or publications.

It is often advisable for the inventor, when having a patentability search made by his attorney before filing the application for a patent, to also have a preliminary infringement search made, by instructing him to study the claims of the patents brought out in his search, to see if any of them would be infringed by the later manufacture and sale of the invention. If this step is taken in the beginning, and it is found that one or more of these patents would be infringed, and which might not be available for purchase or license at a reasonable price, it might decide the inventor not to go to the expense of filing the application on his improvement.

Search by Purchaser or Licensee

Independent infringement searches should always be made by the purchaser or licensee of a patent, through his own patent attorney, before entering into any contract, even though it specifies, as it should in all cases, that the risk and expense of any such infringement will be borne by the inventor or seller himself.

This is necessary because, in the

SYNCROFILM MODEL
"B" SOUND EQUIPMENT

Weber Machine Corp. was first to recognize the needs of the small theatre for a first class sound equipment equal to the best, but at a price in keeping with its abilities to buy and still keep reasonably on the black side of the ledger.

Weber Syncrofilm quality has been recognized from the very beginning. It is among the leading sound equipments, yet is sold at a low price and absolutely free of all extra charges, such as service, fees, etc.

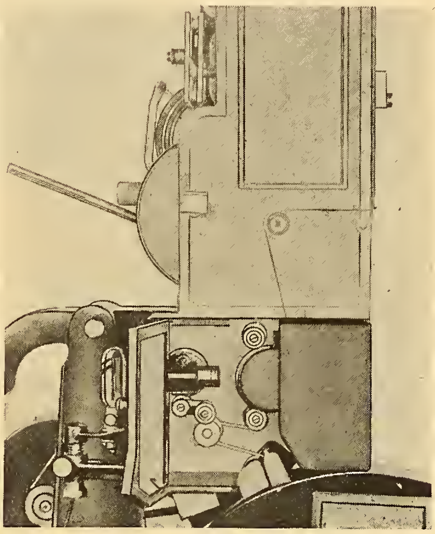
Model "B" is the most advanced. It is already in daily use in hundreds of theatres throughout the country.

$275.00 per pair

Weber Machine Corporation

59 RUTTER STREET
ROCHESTER, N. Y.

Export Department:
15 Laight St., New York City
Cable: "Ariab," New York



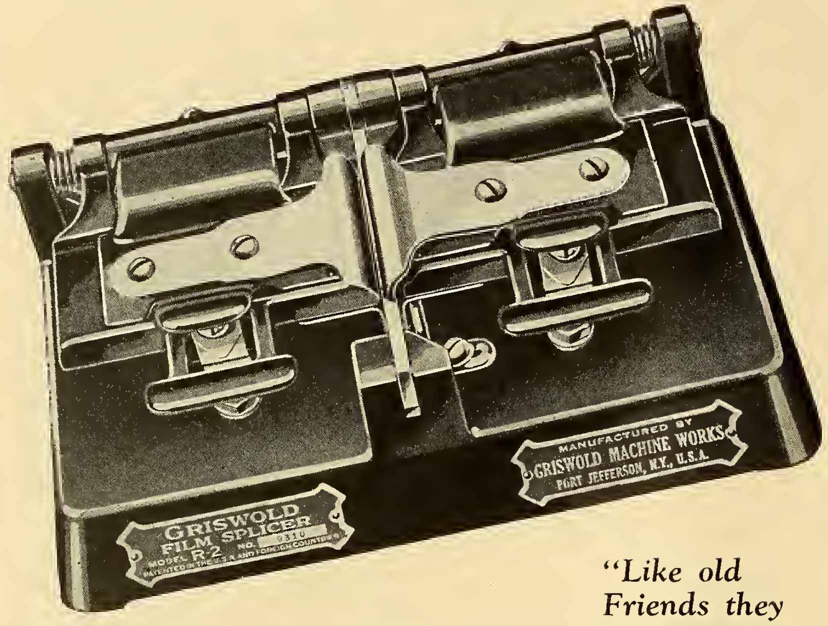
Keep Projection Booths Ventilated and Safe

Here is a fan specially designed for the unusual requirements of projection room ventilation.

No other fan compares, in design, capacity, efficiency and performance to the Vallen Adjustable Volume Fan. The only fan that can be guaranteed to cure your Booth Ventilating troubles.

VALLEN

VALLEN ELECTRICAL CO., INC., Akron, Ohio
DARES TO GUARANTEE



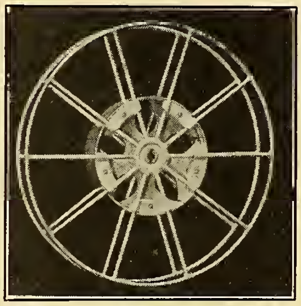
"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS

Port Jefferson, Long Island New York



SOUND REELS

Professional
16Mm. 7" 400 ft.,
35Mm. 10, 11, 14, 15"
for 1000 and 2000 feet.

All Welded
and
Demountable
Types
Cadmium Plated

Patented

WILL OUTLAST ANY OTHER REELS

UNIVERSAL ELECTRIC WELDING CO.

9-16 Thirty-Seventh Avenue Long Island City, N. Y.

Give This to Your Friend—Have Him Fill It in and Mail to us at Once

The Motion Picture Projectionist
7 West 44th Street, New York City

Gentlemen:

Enclosed please find $2.00 for which enter my subscription for one year (12 issues) starting with..............................issue. (Two years, $3.00.) Add 50 cents for Canadian postage; $1.00 for foreign.

Name ....

Street ....State ....

City ....Local No..............................

majority of instances, the inventor is usually financially irresponsible, and so his agreement to protect the purchaser against such legal risks may prove of no practical value; for such suits are usually filed against the more substantial party, who is the true infringer, anyway, and who may be unable thereafter to reimburse himself for any such loss from the penniless inventor.

Also, when operating under a license, it often limits the inventor's liability, as to an amount equal to the total royalties previously paid; and this might be far less than the amount of profits and damages awarded the owner of the patent which is infringed, and so obligate the purchaser to pay the excess.

Requires Skilled Attorney

An infringement investigation and report requires the utmost of painstaking work by a skilled patent attorney. He must first find all the patents issued during the past seventeen years on inventions like or near the inventor's, and then carefully read every claim of these patents on the invention, to determine which ones may be infringed. Where any such infringement appears to exist, the attorney then obtains and studies the file history of such infringed claims to determine their validity and scope that is, whether or not in case of court action, such claims would be held to be both valid and infringed. While the cost of an infringement opinion, particularly if the prior art is voluminous, or the subject matter highly technical, may amount to thousands of dollars, in an average case involving a simple invention the fee should be from $250 to $500. So there is no real reason why anyone purchasing any interest in a patent right should not first take this very necessary precaution, not only to determine the right to use the patent after spending his money for it, but also to eliminate the risk of having to pay heavy profits and damages in the event of a later decision against him.

Represent Insurance Protection

Such searches, then, are not only necessary preliminary steps before purchase or license of patent rights, but they moreover represent highly essential insurance protection against the possibility of large business and financial loss occasioned by the innocent infringement of the patent rights of others.

Then, too, if this step is taken in time, and before the invention appears on the market, it often happens that any patents which may be infringed can be acquired or licensed under for a nominal sum, and before their owner learns of the value and importance of such rights to the purchaser or licensee of the later invention.

(*To be continued.*)

M. G. Sets for Arc Circuits

(*Continued from page* 28)

low for one set of conditions and too high for another and while much can be done by field control yet, to get satisfactory flat performance, a change from say 90 volts to 80 volts flat on a generator usually means not only shunt field regulator manipulation but a change in the series field. It has been found better to offer machines designed to best fit the voltage requirements of the load they will carry. We might add here that different projectionists have their own idea of what the proper arc voltage and the proper ballast drop should be and we find one circuit ordering 80 volt generators for the same identical service where another circuit will specify 90 volts.

Output Ratings

At any rate, it has become well established to begin with 80 volts in the smaller sizes which are used largely with the low intensity lamps whose arc voltage is usually fixed between 50 and 55, and the larger machines, some of which are upward of 30 K.W. which are generally specified as 95 to 100 volt.

Table 1-B

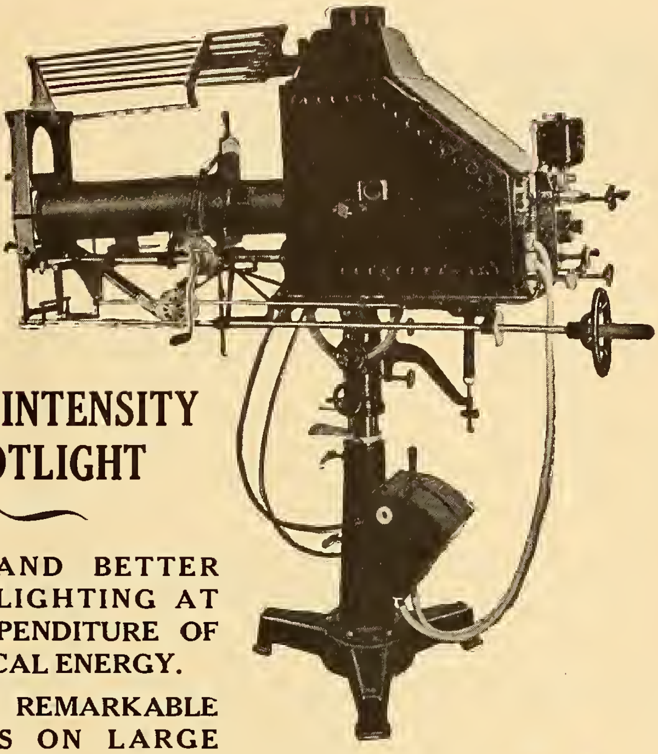
MULTIPLE ARC—TYPE C.P.
A.C. Motors—220—440 or 550 Volts
2 or 3 Phase—60 Cycle

D.C. Amps Continuous	*D.C. Amps 30 Min. Int.*	*D.C. Volts*
	1200 *R.P.M.*	
100	150	100
150	225	100
200	300	100
250	375	100
300	450	100
400	600	100
500	750	100
600	900	100
750	1125	100
	1800 *R.P.M.*	
100	150	85
150	225	100
200	300	100
250	375	100
300	450	100

Too high a ballast drop is wasteful of energy and necessitates the purchase of a larger generator as well as larger ballast units. Too little ballast lays the arc open to the influence of every little line irregularity, to small differences in the burning of the carbons, and necessitates more frequent and accurate feeding to remain within the limits of constancy desired.

Tables 1-A and 1-B indicate what one manufacturer is standardizing in voltage for the various sizes of units. This listing is pretty well in agreement with that of other manufacturers.

Coming then to the generating set itself. There are a number of characteristics which immediately place it



HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.
H&C INC.

SUPER-LITE
SHORT FOCUS
HALF SIZE
LENSES

Increase Illumination
50%
In Comparison With
Quarter Size
Lenses
4″ EF. to 8″ EF. Sizes

PROJECTION OPTICS CO., Inc.
330 Lyell Avenue
Rochester, N. Y. U. S. A.

Better SOUND
Better SIGHT
Greater SAFETY

Here is a Sound Screen that challenges the field on every point that involves perfect projection. It is acoustically correct and free from sound aberration and visionary distortion. It is the final result of scientific application of all fundamental requirements for a better Sound Screen from every angle.

Approved by E. R. P. I.

FEATURES

1. Fireproof.
2. Free from distortion of sight or sound.
3. Acoustically perfected.
4. Eliminates "sound pockets."
5. No glare — restful to the eyes.
6. Easy to clean — lasts longer.

Sold by National Theatre Supply Company, at all Branches.

VISIBESTONE
THE PERFECT FIREPROOF SOUND SCREEN

KEASBEY & MATTISON COMPANY
AMBLER, PENNA.

ask the fellow who uses one!
. . . . he'll tell you

HOFFMANN-SOONS RHEOSTATS *are perfect!!*

Every PERFECTION RHEOSTAT has satisfied its owner. Breakdowns, service-calls and trouble are unknown to *Perfection* users.

THE ONLY UNION MADE RHEOSTAT

Recognized as the Highest Standard everywhere.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to 4/0 without any additional cost.

We build rheostats for special requirements. Communicate with us Direct. There is no obligation.

Sold by all Branches of National Theatre Supply Co., Sam Kaplan, New York, Continental Theatre Accessories, and by your dealer.

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 FIRST AVENUE, NEW YORK
Contracting Electrical Engineers—Moving Picture Theatre Electrical Specialists

a little above the average of such apparatus in quality. To enumerate, it must be:

1—Reliable.
2—Quiet running and free from vibration.
3—It must not drop off in voltage and consequently in amperes when additional load is put on.
4—It must be decidedly free of voltage ripples. Such ripples are likely to cause disturbing noises.

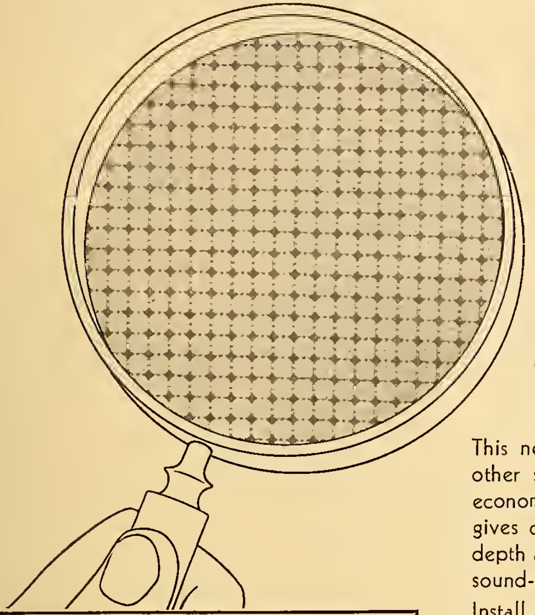
Reliability is a factor often overlooked until the owner has had a dark house. The larger circuits generally provide for this by the installation of duplicate sets either of which will run the show. This gives full protection. Other than this, apparatus is often provided so that, if the generator fails, recourse can be had to A.C. through a choke coil or other device. Of course such a picture is very unsatisfactory after running on direct current, and the proper solution in every case is to use the best generator that can be bought and give it good care. It must be remembered that the generators are usually given pretty severe service, operating in many places for long hours every day at a point near full load with shots of severe overload.

Suggestions for Installation

Quite often the owner or architect does not give the generating set the attention it deserves when the house is being designed. It may be placed in a location where even a slight noise is telegraphed to the audience either through the air or through the supporting beams. Sometimes elaborate precautions are taken to support the unit on cork, rubber, or springs, only to bolt it down against the beams of the floor, thus entirely neutralizing the benefits hoped to be derived from the cork, rubber, or springs. The set is generally so well balanced mechanically that no bolts should be required. Even the fastening of the pipe conduit rigidly to the set and leading it into the concrete will carry considerable disturbance into the house.

The generating unit consists of parts of considerable weight, some of which rotate at high speed and are bound to cause some noise and vibration. In addition there are magnetic and brush noises that must be damped down to the lowest possible point. The building of these sets has become a very much specialized art, yet there are some theatre owners who will accept a unit built up at random out of any kind of commercial motor and generator so long as it will deliver current regardless of regulation, noise or efficiency.

A very noticeable fault in many multiple sets is the falling off in voltage, and consequently current, when the second arc goes on. This dropaway is not always, to be sure, en-



METALATONE
The New All-Aluminum
METAL-MESH SCREEN
makes any Sound Picture
A BETTER ATTRACTION

AFTER several years of exhaustive research and projection tests, here's the only absolutely 100 per cent fireproof screen now in use. It has proved itself to be also the **most perfect, most efficient, most durable and effective projection surface for sound pictures** in use anywhere today. Loew's Astor Theatre, New York City, estimates 100 per cent improvement in sound reproduction through this screen.

This new screen is made of flexible, flat aluminum metal mesh. It surpasses all other screens in ease of installation, durability, cleanliness and maintenance-economy, and is remarkably light in weight. It is superior in light-reflection value, gives clearer detail of sight and sound, produces pictures that have the superb depth and tone value from every part of the house. Being metal, the area of the sound-spaces can never fuzz-over.

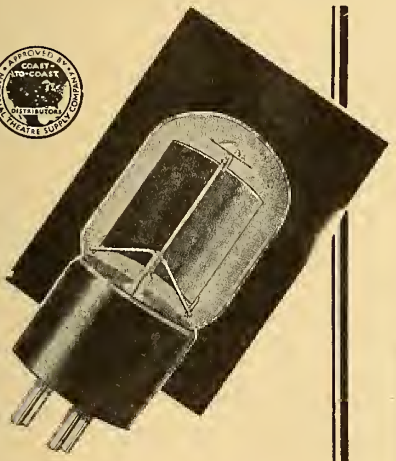
Install one of these new metal-mesh screens and you'll make every picture a better show and your theatre a safer place.

- BETTER SOUND reproduction
- CLEARER Pictorial Detail
- NO FADE-OUT from any angle
- Sound spaces ALWAYS CLEAR-CUT
- UNEQUALLED DURABILITY
- EXTREME LIGHT WEIGHT
- ALL ONE-PIECE no seams
- 100% FIREPROOF all metal-mesh

APPROVED BY R.C.A. PHOTOPHONE AND ELECTRIC RESEARCH PRODUCTS, INC.

Manufactured under U. S. Patent No. 83,752 by
WHITING & DAVIS COMPANY
World's largest manufacturers Metal-Mesh Bags
Plainville (Norfolk County) Massachusetts
and Distributed by
RAVEN SCREEN CORPORATION
147 East 24th Street, New York, N. Y.

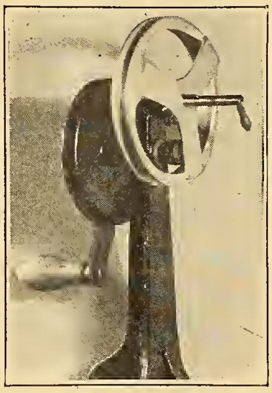
WRITE OR WIRE FOR DETAIL INFORMATION



for perfect reproduction of sound and freedom from photoelectric cell trouble, order Visitrons from National Theatre Supply Company.

PHOTOELECTRIC CELLS
VISITRON
REG. TRADE MARK

G-M LABORATORIES INC
1753 BELMONT AVE., CHICAGO, ILL.



Complete your booth equipment with a
"BEST" REWIND PULLEY
Takes the place of space collar on reel shaft—Crank is not removed.

Price $2.50 at your dealer

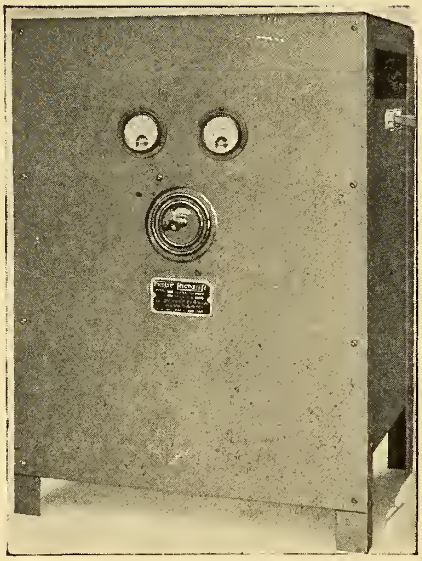
Manufactured by
BEST DEVICES CO.
2108 Payne Avenue, Cleveland, O.

WALKER SOUNDSCREEN

The Aristocrat of White Screens

INSIST ON THE BEST

Good Projection Requires Good Rectification



M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes, then the other two, as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP.
New and Wilsey Sts.
Newark New Jersey

tirely the fault of the set but may be due to excessive line drop.

Taking up this last item first. Suppose the generator is located several hundred feet away from the projectors. The bus lines are led into a panel from which the several circuits lead to the respective projectors and their ballasts.

Allowable Line Drop

It is obvious that any drop in the line between generator and panel will affect both lamps and if this circuit is long, even though the Underwriter's rules as to wire sizes are followed, there is a noticeable amount of line drop. In such cases a very marked improvement will be made if separate lines are run to each projector from the generator. In such case the resistance of these lines becomes part of the ballast and the smallest wire size permitted by the Underwriter's will suffice.

If the fault is in the generator it may be due to any one or a combination of several contributing causes. The motor may have such a high squirrel cage resistance that it drops its speed on overload. The generator may be under compounded. The whole set may have been chosen too small for the load it is to carry. The line voltage may be too low to suit the winding of the motor. The line drop in the supply circuit may be too great so that when the overload comes on and the motor demands full voltage, it is actually getting a voltage too greatly reduced. This condition is mentioned in particular because there have been cases where standard 220 volt machines have been put on 208 volt lines and while this comes within the 10 per cent latitude permitted under the rules it makes it rather uncomfortable for the motor when called on to deliver a heavy overload and maintain its speed so as to deliver full D.C. voltage at the arc.

The matter of voltage ripple is one of eternal vigilance in electrical design. It is only one of the additional items of refinement demanded brought about largely by the addition of sound to the picture.

INSURE YOUR JOB!

Study F. H. Richardson's

Handbook of Projection

Three volumes containing over 1,400 pages of vital knowledge with question and answer index. Every projectionist needs this authoritative guide. See your local theatre dealer or send for full details.

CHALMERS PUB. CO.
516 Fifth Ave., N. Y.

Index of Advertisers

Best Devices Co. 41
Brenkert Lt. Proj. Co. 6

Chalmers Publishing Co. 42

Eastman Kodak Co. 5
Electrical Research Products, Inc. 3

Fish-Schurman Corp. 5
Forest Electric Corp. 42

General Machine Co. 35
G-M Laboratories, Inc. 41
GoldE Mfg. Co. 33
Griswold Machine Works 38

Hall & Connolly, Inc. 39
Hertner Electric Co. 4
Hoffmann-Soons, Inc. 40

International Projector Corp. .... Back Cover

Kaplan, Sam, Mfg. & Supply Co.. 2
Keasbey & Mattison Co. 40

McAuley, J. E. Mfg. Co. 8
Movie Supply Co. 42

National Carbon Co. 9
National Theatre Supply 43

Projection Optics Co. 39

RCA Photophone, Inc. 7
Roth Bros. & Co. 10

Service-On-Sound Corp. 36
Strong Electric Corp. 35

Telephoto & Television Corp. ... 33

Universal Electric Welding Co. .. 38
Vallen Electrical Co. 37

Walker Sound Screen 41
Weber Machine Co. 37
Whiting & Davis Co. 41

THEATRE EQUIPMENT
NEW AND USED

Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.

Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.

We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.

Everything for the Theatre—Write for Catalog K.

MOVIE SUPPLY CO., 844 So. Wabash, Chicago

Where Service is More than "Mere Sales Talk" . . . . .

Make it a point to look around the next time you drop in at National. You'll find plenty of service in evidence . . . full stocks of supplies and accessories; bins full of *genuine* repair parts; demonstrating apparatus; "loaner" equipment for emergency. You'll see the latest mechanical developments on display and the salesmen are never too busy to discuss your problems with you. In fact, you don't have to be told about National Service—you see it and feel it the minute you step into the store. Come in often and get better acquainted with what we have to offer you.

COAST-TO-COAST
DISTRIBUTORS

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

IT PAYS TO DO BUSINESS WHERE YOU'RE ALWAYS TREATED RIGHT!

REPAIR—REPLACE NEWS

VOL. I, NO. 2 NOVEMBER, 1931

REPLACE WITH SIMPLEX PROJECTORS

Good Projection Vitally Essential to Prosperity of M. P. Theatre

The picture, to have the proper entertainment value, must be rock-steady, perfectly sharp in focus, with lines absolutely unblurred and its contrast values undamaged by shifting lights. Each succeeding film photograph must register with minute precision with the one directly preceding it over the projector aperture, and the screen itself must be evenly illuminated and also lighted with a brilliancy suited to the individual needs of the theatre concerned. Failure to comply with the above specifications results in an unsteady, blurred picture of no entertainment value—no matter how good the film—and the resultant falling off in b. o. receipts. GOOD PROJECTION MAKES ALL THE DIFFERENCE BETWEEN FAILURE AND SUCCESS TO ANY PICTURE.

Projector manufacturers have expended thousands upon thousands of dollars, and years of experimental research in trying to perfect their methods of manufacturing parts. Measurements of ten-thousandths of an inch are now a regular part of shop routine, and this simply goes to show how infinitely accurate must be the registration of the projector at the time it is installed in a house. It only remains for the exhibitor to keep it up to the minute in repairs and additions which may be found necessary from time to time. EXHIBITORS MUST AWAKE TO THE ULTRA-IMPORTANT PART PROJECTION IS PLAYING IN THE LIFE OF THEIR THEATRES. THEY MUST REALIZE THAT THE PALTRY FEW DOLLARS THEY MAY SUCCEED IN SAVING ON THEIR PROJECTION REPAIR BILL WILL ASSUME UNRECOGNIZABLE PROPORTIONS AS COMPARED TO THE FALLING-OFF IN ATTENDANCE AS REGISTERED BY THE BOX-OFFICE REPORT. And they must realize that good projection is no longer a matter of speculation—but a 100% gold-bond investment, with the resultant profits bearing a distinct relation, comparatively, to the original sum invested.

D. E. CRANDALL

Simplex
The International Projector

Neglect a Grave Mistake

It is a grave mistake to neglect repairs on any machine and this is particularly true of the motion picture projector. The mechanism of the motion picture projector is designed to handle the inflammable and delicate film so that danger and damage may be avoided even at the excessive speed the projector is sometimes operated in some theatres. IT IS, HOWEVER, NECESSARY THAT THE MECHANISM BE KEPT IN EXCELLENT CONDITION AT ALL TIMES AS A DEFECTIVE PART IS BOUND TO EVENTUALLY CAUSE SERIOUS TROUBLE.

It has long been my belief that a "stitch in time saves nine," for a wear on one part starts up a chain of wear. AND IT IS REALLY THE HIGHEST FORM OF ECONOMY TO MAKE REPAIRS JUST AS SOON AS THERE IS ANY INDICATION THAT THEY ARE NEEDED. Where repairs can and should be made by our own projectionists we do the work, but under no circumstances are repairs made by us which should be made by the projector manufacturer or where replacement is really necessary. Care, experience, skill, loyalty and pride in their work on the part of the men and liberal expenditures by the management are needed, but they certainly pay in the long run.

HARRY RUBIN
Director of Projection, Publix Theatres

Three Projectors an Economy

I have always been an advocate for THREE PROJECTOR installations and think that every theatre, both large and small, should have three complete projectors in the projection room and all three should be in first-class working condition at all times if possible. I say if possible because at some time no matter how careful you are one projector is liable to go bad and it should not be allowed to be out of commission any longer than is necessary to put it back in good condition again. I have had the occasion to repair one projector while keeping the show going along on the other and we all know that this is not an easy task. With a THREE PROJECTOR installation it would have been but a short wait to take the film from the disabled projector and continue the show on the third, repairing the laid up projector at leisure and thereby doing a better job.

Then again IF YOU ALTERNATE ON THREE PROJECTORS YOU WILL LENGTHEN THE LIFE OF THEM ALL AND I BELIEVE THAT THREE PROJECTORS USED ALTERNATELY WILL BE OF SERVICE MORE THAN THREE TIMES LONGER THAN A TWO PROJECTOR INSTALLATION. I HAVE SEEN PROJECTORS USED UNTIL THEY WERE ALMOST READY TO FALL APART BEFORE THE MUCH NEEDED REPAIRS WERE MADE.

CHARLES H. TRAVIS
Schenectady, N. Y.

REPAIR WITH GENUINE SIMPLEX PARTS

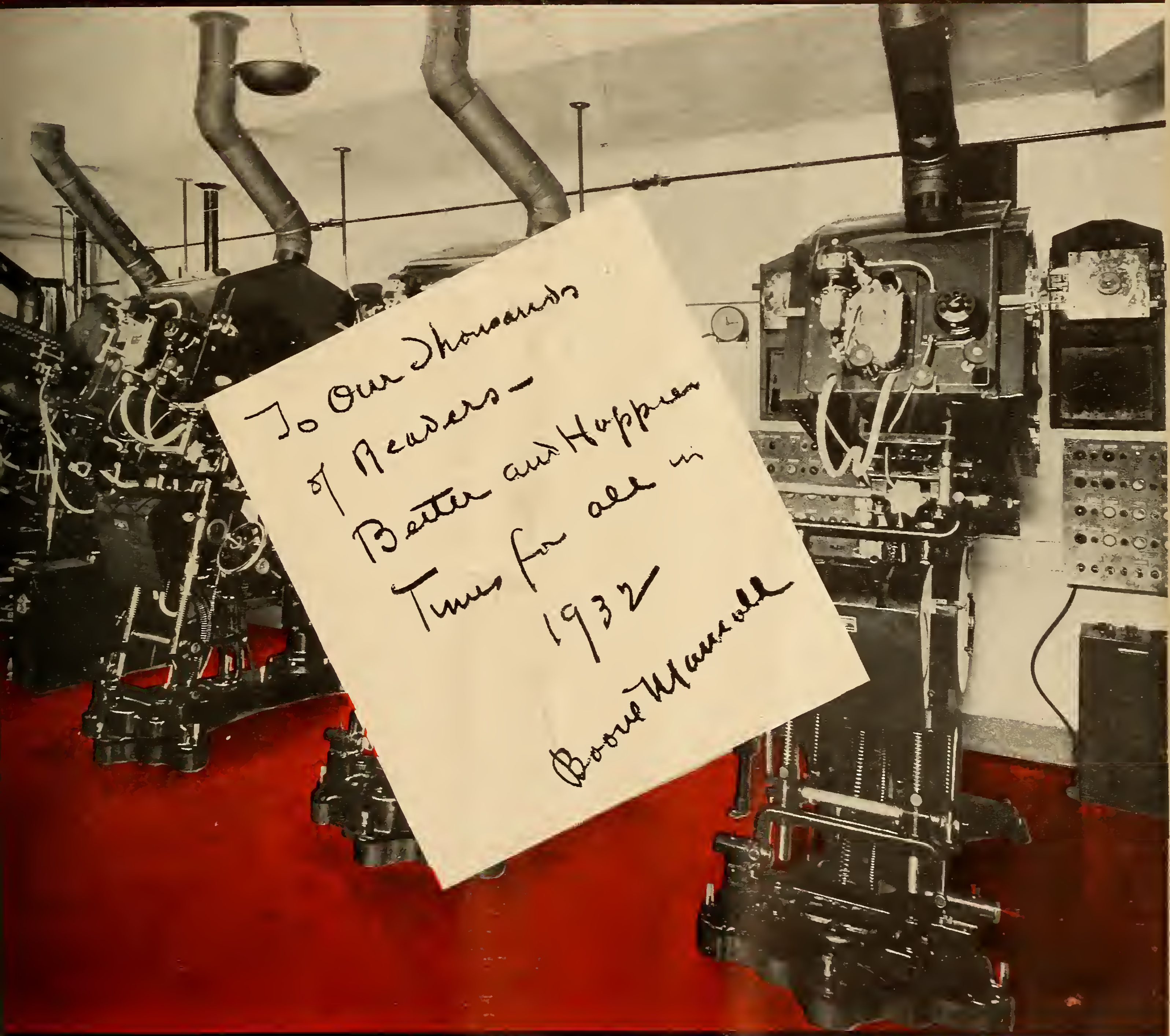
Have You Studied the Safety of Your Projection Room?

Let us look over the projectors. 1918 Model and looking as though, as far as overhauling is concerned, they have been forgotten since that year. It's hardly necessary to look at them; just listen to them—every rattle tells a story. Gear teeth worn to a knife edge, bearings that have become literally egg-shaped instead of round, enough blacklash to allow nearly half a turn in the gear train without moving the film. The shutter gears so worn that it is impossible to project a picture without "travel ghost" and film guides that are worn to a wafer thickness. You ask, what has the sad mechanical condition of the projectors to do with safety? The answer is simple: A WORN PROJECTOR WILL LOCK AND JAM SIX TIMES AS OFTEN AS ONE IN GOOD REPAIR. Film is moved down through the projector mechanism by the teeth on the sprockets. If these teeth are worn down or the gearing which actuates the movement of the sprocket locks, it is evident that the film will sooner or later cease movement. Remember that the heat at the aperture is greater than the flash-point of the celluloid. If any part of that mechanism stops functioning for one-quarter of a second nothing more is necessary to start a fire. Where it may end is largely a matter of conjecture.

GEORGE C. EDWARDS
American Projection Society, Inc.

INTERNATIONAL PROJECTOR CORPORATION
90 GOLD STREET NEW YORK

MOTION PICTURE PROJECTIONIST



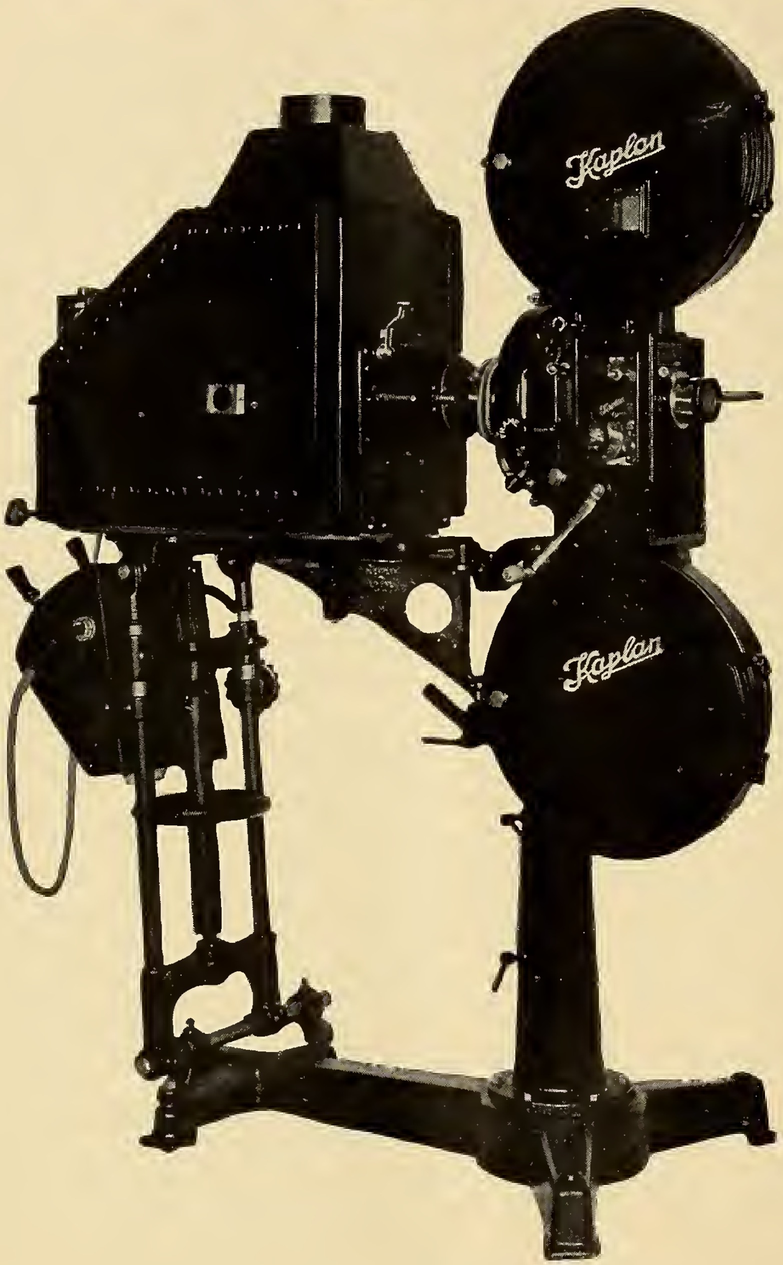
To Our Thousands
of Readers—
Better and Happier
Times for all in
1932
Boone Mancall

Published by the MANCALL PUBLISHING CO., Boone Mancall, *President*
Editorial and Advertising Offices, 7 West 44th Street, New York City
Entered at New York Post Office as second class matter, October 25, 1927

Vol. 5 • No. 3
25c per copy $2 per year

January, 1932

FIFTH YEAR OF PUBLICATION



Kaplan

PROJECTOR

The Kaplan Projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

An Engineering Product

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue -:- -:- New York City

Leadership is Progress

NATIONAL Projector Carbons hold recognized leadership for all types of projection equipment.

Leadership is achieved and maintained only through progress. The Motion Picture Industry has attained its high rank in the business world as a result of steady progress . . . Improved quality of direction and photography . . . Larger and more beautiful theatres . . . Higher standards of service . . . Sound . . . Color . . . Better screen illumination. The march of PROGRESS.

National Projector Carbons keep pace with the progress of the industry. Backed by splendid research and manufacturing facilities, they meet or anticipate each new demand. The new National S R A Carbons and Pre-Cratered High Intensity Carbons are recent improvements making possible better projection and steadier screen illumination.

Use National Projector Carbons in your theatre. You will find the steady brilliance of screen illumination pleasing to your audiences and a source of increased patronage.

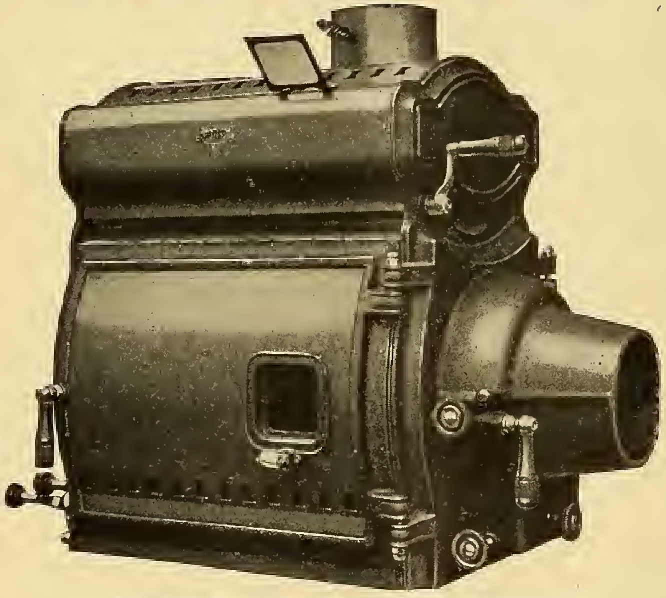
NATIONAL
PROJECTOR CARBONS

. . . Sold exclusively through distributors and dealers. National Carbon Company will gladly cooperate with the producer, exhibitor, machine manufacturer or projectionist on any problem involving light.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division , Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York Pittsburgh Chicago San Francisco

THE NAME
Brenkert
IS YOUR GUARANTEE OF
ENTIRE
SATISFACTION
ELIMINATE GUESSWORK!
SPECIFY BRENKERT
for Brenkert projection equipment has consistently produced the utmost in performance with a minimum of maintenance expense.

Distributed by Progressive Independent Supply Dealers



The Brenkert Super High Intensity Projection Lamp

Ask Any User — A Brenkert PRODUCT — Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

Britain Views Aperture Standardization

THE manner in which the new aperture standards as proposed by The Academy of Motion Picture Arts and Sciences is being received in England is reflected in the following excerpts from an article on the subject which recently appeared in *The Bioscope*, a representative weekly of the British motion picture industry:

"When this question of aperture sizes was under consideration about two years ago, the studios were exposing for the full silent picture frame 0.68 in. by 0.906 in. This aperture was equally suited to sound on disc prints, and sound on film not being in general use, cameramen were content to allow the laboratory to mask off 0.1 in. of the picture to accommodate the sound track where sound on film was needed.

"This practice resulted in some theatres following the studio scheme and masking the sound track only; thus obtaining an almost square screen picture for sound on film and reverting to the 3 by 4 oblong screen for disc subjects.

"This did not find favor with the majority of the theatres, and it therefore became the general practice to mask in portions at the top and bottom of the frame to screen a 3 by 4 image, the necessary magnification of the smaller film picture to fill the same screen size as used for silent and sound on disc subjects being attained by the use of a supplementary lens or a shorter focus projection lens.

"Projector manufacturers fell into line and Simplex, Ernemann and Kalee machines are now fitted with easily interchangeable apertures for sound on disc and sound on film prints. The new proportional aperture for sound on film is, in most cases, 0.6 in. by 0.8 in.

"Having regard to the increasing use of sound on film, A.M.P.A.S. suggests a standard camera aperture 0.651 in. by 0.868 in., which would render possible a projection aperture 0.615 in. by 0.820 in., an increase of about 4 per cent. over that at present in common use.

"Standardization will simplify work in the studio, making it possible to utilize slightly smaller sets and to effect a slight reduction in production costs.

"A certain measure of advantage is offered to the theatres also. A 4 per cent increase in screen size without additional magnification is obtainable.

"The changes proposed will affect the minimum number of theatres, and where changes are needed the cost will not be high unless new lenses are required.

"If the silent aperture has been in use and the theatre does not wish to change lenses, the new aperture will result in a reduction of about 18 per cent in the screen size. Unless new lenses are introduced a theatre where the sound track only has been masked will find a reduction of about 7 per cent in the screen size. Shorter focus lenses would enable the screen size to be maintained unaltered in both these cases.

"Some exhibitors may consider that the present aperture, 0.6 in. by 0.8 in., would make an effective standard with the least outlay for the theatres; particularly as whatever standard is adopted will benefit the studios. If this were done 4 per cent of the already limited space available on the film would be wasted, and this is hardly a thing to be aimed at when setting up a permanent standard.

"It might be thought that the graininess of the picture would be enhanced by the increased magnification necessary, but general practice with the proportional aperture has proved that this is not a serious matter. The smaller aperture will perhaps reduce the amount of light which can reach the screen, but here again current practice shows that this proposal need not be seriously considered, particularly as the aperture to be standardized will be slightly larger than that now in general use.

"Standardization is to be welcomed, for it will save trouble to the studio, the laboratory and the theatre."

MOTION PICTURE PROJECTIONIST

January, 1932 Vol. 5, No. 3

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency*; J. H. Kurlander, *Light*; J. E. Robin, *Equipment*; W. W. Jones, *Theory*; Harry Rubin, *Improvement*; Victor Welman, *Personnel*; Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Mortimer Glancoff

Editorial & Advertising Office
7 West 44th St.
New York City.

New Stereoscopic Projection System Announced

The announcement was made recently by Mr. Douglas Winnek, cinematographic engineer, of the development of a new method for the projection of stereoscopic motion pictures. The device is the invention of Mr. Winnek, who states that it makes possible a perspective of three dimensions without the necessity for special viewing devices.

The new method devised by Mr. Winnek provides for the use of a new type of projection screen with a beaded cellophane surface. Each bead functions as a lens. There are, it is said, 576 beads to the square inch. The pictures are taken with a binocular camera, which is equipped with two lenses, one, of course, taking the picture as seen with the right eye, and the other as seen with the left. These pictures are then combined or superimposed on the special screen through the use of the binocular projector.

YOU'RE GIVING BIGGER VALUE FOR THE SAME MONEY

THE majority of current productions are being photographed on Eastman *Super-sensitive* Panchromatic Negative. Amazing in its qualities, limitless in its possibilities, this new film is bringing you better-directed, better-acted, better-photographed, better-finished pictures. In tune with the times, you are now able to give your patrons bigger value than ever...for the same money. And that fact is bound to mean better business for your theatre.

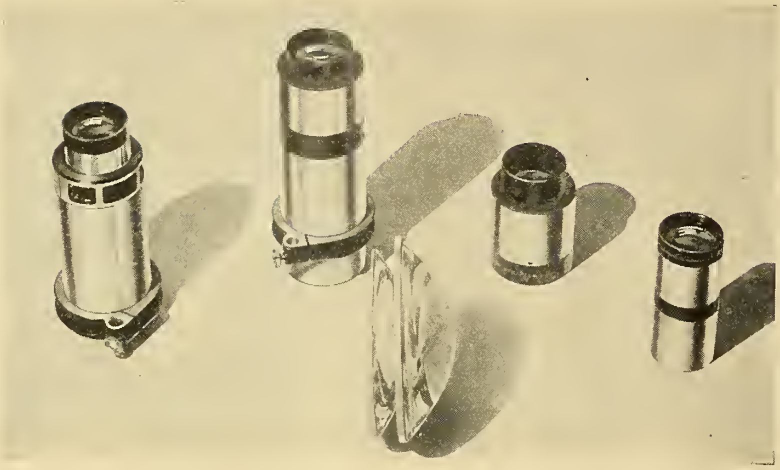
EASTMAN KODAK COMPANY

J. E. Brulatour, Inc., Distributors
New York Chicago Hollywood

F. S. C.
Optical Crown Plates
For enclosing Portholes of Projection Booths
PRECISION SURFACES
NO DISTORTION

S. O. G.
"IGNAL" CONDENSERS
Made of extra heat resisting Optical Glass
ALL SIZES
ALL FOCAL LENGTHS

Sole Distributors
FISH-SCHURMAN CORP.
230 East 45th Street New York City, N. Y.



Get Aboard the Large Picture Trend With Super Cinephor!

THERE'S no denying the trend to larger pictures, and their appeal to the public must be recognized by every theater operator. The modern theater must be prepared for wide film and wide screen requirements while continuing to give the best in the way of standard screen projection.

Super Cinephor and the new B & L Condensing System meet this demand exactly. Super Cinephor is the first true anastigmat. Corrected for wide angle projection, and made in focal lengths down to 2 inches, it produces sharp, clearly defined images to the very margin of the screen.

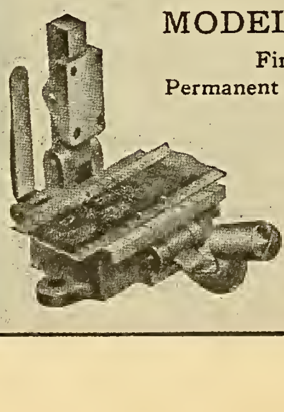
It distributes the light so efficiently that even on wide or giant screens the image has exceptional brilliance. It's got a projection punch that means profits. Are you missing this opportunity to make a moderate investment that will put your showings out in front?

Catalog E-16 gives complete description and valuable information for the projectionist.

TO GREATER VISION THROUGH OPTICAL SCIENCE BAUSCH & LOMB

BAUSCH & LOMB
OPTICAL CO.,
680 St. Paul Street,
Rochester, N. Y.

BAUSCH & LOMB



Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film
Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.

For sale by all Supply Dealers

Sound Pictures in Industry

The Reo Motor Company has contracted for the installation of RCA Photophone sound reproducing equipment in the auditorium maintained by the automobile company at its plant in Lansing, Mich., according to an announcement by E. O. Heyl, vice-president and general sales manager of RCA Photophone, Inc.

"The Reo Motor Company, in line with other large industrial corporations which have begun to appreciate the value of sound motion pictures in connection with the merchandising of their product, is installing RCA Photophone apparatus not only for entertainment purposes but for the presentation of sound sales talks to their employees and representatives," said Mr. Heyl. "The widespread interest in this modern phase of advertising is becoming more apparent every day."

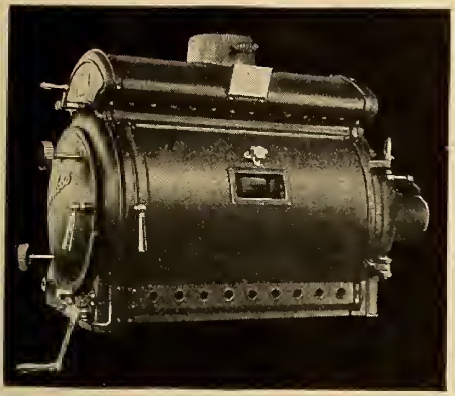
Many other automobile manufacturers are employing RCA Photophone portable sound reproducing apparatus in branch offices all over the world. The Chrysler Automobile Company recently recorded a sound picture showing the development of its new Plymouth car and it has been shown on portable apparatus in many cities.

Strong Electric Reports Business Increase

The Strong Electric Corporation of Toledo, manufacturer of high intensity automatic reflector arc lamps, reports a substantial increase in its volume of business during the past month. Among the sales noted were a number to the United States Government, the equipment being destined for the Army Motion Picture Service for installations at Fort Bennings, Georgia, the Naval Academy at Annapolis, and the U. S. Military Academy at West Point. Units were also purchased by the Government for installations located in the Canal Zone. A number of foreign shipments are cited in the company's announcement, notably of equipments for the Canadian Pacific Company's two new Liners, the S.S. *Empress of Japan* and the S.S. *Empress of Britain.*

New York or Washington for S.M.P.E. Spring Meet

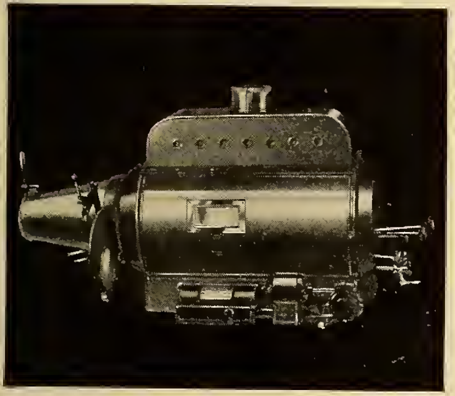
The Board of Governors of the Society of Motion Picture Engineers has voted that the Spring Meeting of the Society of Motion Picture Engineers shall be held in either Washington or New York City, with a tentative date set for May 9 to 12. Choice between these two cities will be made by the members of the Society and ballots have been mailed to the members for their votes, according to W. C. Kunzmann, Chairman of the Convention Committee.



Peerless

"The Super Reflector Arc Lamp"

DEPENDABILITY!



COMPLETELY
ELIMINATES THAT
FEELING OF
"EXPECTANCY"
FROM THE BOOTH

LEADING Projectionists, Engineers and Authorities of the industry agree that Peerless Reflector Arc Lamps are their "Preferred Choice." . . . Peerless has won this enviable position by virtue of its inherent ability to uncomplainingly **stand up and deliver** under any projection requirement; and to do it most economically, with greater performance satisfaction, at a minimum upkeep expense and by far with the least mechanical attention . . . You can always depend on Peerless.

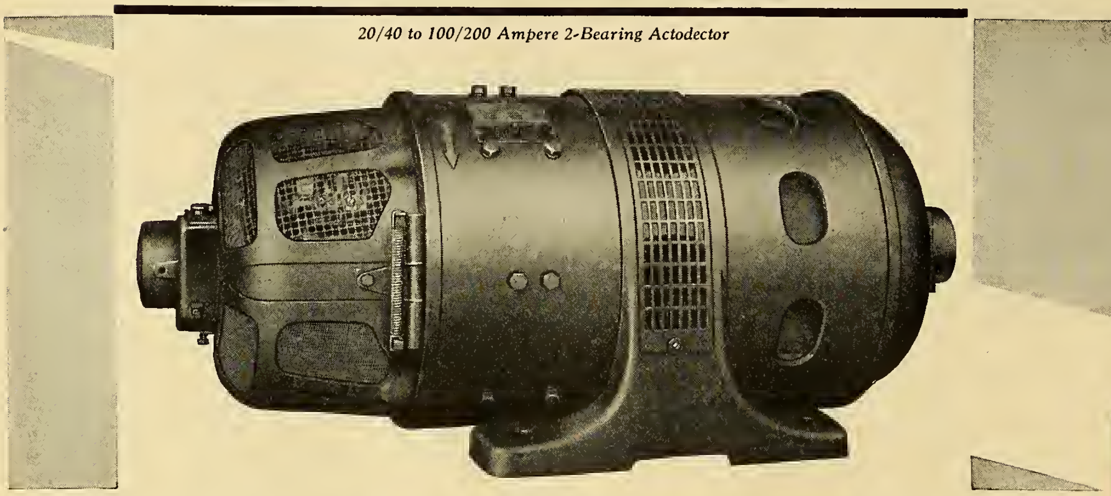
Why Speculate?

Manufactured by

J. E. McAULEY MANUFACTURING COMPANY
552-54 West Adams Street, CHICAGO, ILL., U. S. A.

ROTH ACTODECTORS

20/40 to 100/200 Ampere 2-Bearing Actodector



THEY KEEP A-RUNNING

ROTH ACTODECTOR CONTROL PANEL

Projection Arcs of UNIFORM INTENSITY

Screen illumination of continuously uniform intensity and unvarying brilliance—even during change-over—is secured by the use of Roth Multiple Arc Type Actodectors, because they supply steady voltage to the arcs under changes in load.... Any number of arcs can be carried within their ampere ratings—sizes range from 20 to 600 amperes.... They are accurately built and liberally proportioned to meet projection booth requirements for sound or silent pictures.... Their dependability of operation is the result of thirty-eight years of experience by Roth Engineers in perfecting balanced construction throughout the entire unit—Actodectors, resistors and control panels.... Furnished in 2- and 4-bearing types, dynamically balanced.

ROTH
Emergency Lighting Plants

are giving thoroughly dependable protection in many of the largest circuit and independent theatres.

ROTH

ROTH BROTHERS AND CO.
Division of Century Electric Company
1400 W. Adams St. Chicago, Ill.
Distributors and Offices in all Principal Cities

■ DIRECT CURRENT MOTORS ■ GENERATORS ■ MOTOR GENERATOR SETS ■ ROTARY CONVERTERS ■

As The EDITOR *Sees* IT

¶ *The Emperor's Clothes*

THE stage, in its visual aspects, presents an illusion the shortcomings of which, through long association or for some more obscure reason, we have somehow come to accept. In the Chinese and other Orientals this attitude toward the theatre is highly developed—or perhaps the reverse, depending upon how one views the matter—and the Eastern stage dispenses with the theatrical properties of Occidental civilization almost in their entirety.

Where the reproduction of sound is concerned, it is, however, a vastly different story. Although possibly more nearly approximating the original in the reality of its illusion than stage properties approach the visible world, we are deeply conscious of its shortcomings. All this despite the herculean efforts of the high-power press agent, who by virtue of sheer lung capacity and endurance has tried to convince us that the millennium is at hand.

As we enter upon the new year, it would not seem amiss for the motion picture industry to take inventory of its accomplishments. The goal can be nothing short of perfection, but how nearly has that perfection been attained? Is it even imminent? Should we be satisfied with things as they are? What do we see? What do we hear?

Is the motion picture, amazing though its progress has been, as convincing as it should be? Even with the enhancement of modern color processes, does it ever so remotely approach the illusion of reality? Has the mechanical reproduction of a living voice or of a great orchestra the emotional qualities, the power, and the conviction of true audition? Or is the American public, while listening to music with a persistency never before known, being in that very act deprived of the essentials of music?

It is. Let us be honest with ourselves. We are victims of a transition period in the scientific development of a new art—or, rather, a new vehicle for artistic expression. We are standing somewhere near the halfway mark between the thought and the thing. We have cast off the old, and the new is not yet ready.

The indications are, however, that this transition period is fast drawing to a close. We hear talk of stereoscopic vision, binaural hearing, the application of color, and wider frequency range. What is more, it is not all talk. Much that is important is being accomplished. New vistas are opening before us, and occasionally it is granted us to catch a fleeting glimpse of what the future holds in store.

Such was the case at the recent demonstration, held at Engineering Societies Auditorium, New York City, of the new hill and dale method of recording as developed by the Bell Laboratories. Perhaps, in speaking of the demonstration, one had best refer to it as a revelation of advanced reproducing methods with the new disc as the central factor, because, after all, the amazing results were not achieved through the use of the new disc alone, but were rather the combined result of disc, pickup, amplifier and speakers. And the speakers, be it known, were just as amazing as the disc. A speaker which responds to twelve thousand cycles is no mean accomplishment, even in this day of scientific miracles.

The overwhelming impression gained on listening to the reproduction was its amazing clarity and lifelike tonal quality—none of that muffling which has hitherto served to identify recorded music—but a free sweep of tone, rich and convincing, that played upon the emotions with all the subtle power of an original rendition. The reproduction was by no means perfect—one could hardly expect that at the present stage of development—but it was, in our opinion at least, by far and away the nearest approach to genuine music which has yet emerged from a loudspeaker horn.

The importance of this latest development in sound recording and reproduction, and its value to the motion picture industry, and in fact to the world at large, are inestimable—one cannot reckon the emotional value of an overtone in terms of mundane currency—it means that the public will soon be able to hear in musical reproduction something of the breadth and soul of the original, rather than a gamut of smothered rhythm.

The scientists and engineers of the Bell Laboratories are deserving of the heartfelt gratitude, not only of the motion picture industry, but of a long-suffering and sorely afflicted public.

Mr. Halsey A. Frederick and his assistants of the Laboratories staff are to be commended for the masterly manner in which the demonstration was conducted. The choice of Mr. Leopold Stokowski as one of the speakers of the evening was a particularly felicitous one and lent an air of artistic distinction to the occasion.

Last, but not least, we nominate for the Royal Order of Merit the Society of Motion Picture Engineers, under whose auspices the demonstration took place. It was a meeting of which the Society may well be proud.

CHARLES E. BROWNELL.

Projector Drive Motors

By **Albert Preisman**

Since the advent of sound the projector drive motor has become a factor of greater importance than ever before. Ease and precision of control affording definite, constant and unvarying speed are today imperative. The author discusses the underlying principles of the common types of projector motors and explains in non-technical language how the new demands are met in modern motor design. Mr. Preisman is an electrical engineer of wide experience. He is a graduate of Columbia University and is at present in the employ of RCA Photophone.—THE EDITOR.

IN considering sound reproducing equipment, we must not let the fame of the vacuum tube obscure from our notice another essential part of the equipment, the projector drive motor. The following article will concern itself first with the induction and synchronous motors, as these are the most important types in theatre use, yet the least understood of rotating electrical machinery. Then will follow an exposition of the D.C. projector drive motor.

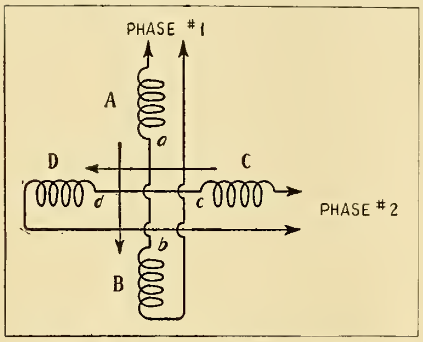


Fig. 1. Two Phase Winding

General Principles

1. All motors in practical use today depend upon the fundamental motor principle that a wire suitably situated in a magnetic field will move across the field when a current is passed through it. By placing such wires around a shaft, and passing a magnetic field through this assembly, the wires may be caused to "chase" themselves around the shaft, thus producing rotational motion. The direction of motion of the wire depends upon two things:

(a) The direction of the current through the wire, and

(b) The direction of the lines of magnetic force through the wire.

If both simultaneously reverse, the direction of motion of the wire remains the same as before.

2. If instead of passing a current through the wire to cause it to move, we move it mechanically, and, let us say, in the same direction, a current will tend to flow in the *opposite* direction, due to the electro-motive force induced or generated in the wire as the latter cuts the above magnetic lines of force. This is the generator principle.

3. In any electromagnetic system both principles are in force, and in opposition to each other. When current is forced into a motor, a mechanical force is generated, causing the rotating part (rotor) to turn. As it turns, a counter-electromotive force is induced in it, which opposes the impressed voltage causing the current to flow, and thus tends to decrease the latter. That is why, when a motor is rotating, it draws less current than when connected while at rest to the power supply, and is therefore the reason why starting resistors or impedances are required during the initial starting period, especially for large, heavy machines, that take considerable time to come up to speed.

4. A magnetic field may be produced by passing a current through a coil of wire wound on an iron core. If the current flows in one direction through the coil, the lines of magnetic force are in one direction; if the direction of current is reversed, the direction of the magnetic lines is reversed, too. The magnetic field is at all times proportional to the current flowing through the coil of wire.

Alternating Current

5. A current may flow continuously in one direction, or periodically reverse itself. The latter is known as *alternating current.* One complete reversal or alternation of such a current is known as a *cycle*—meaning, in general, a series of events. The number of cycles per second is called the *frequency* of the supply. Thus, an alternating current power system in which the current makes sixty complete alternations or cycles per second is said to have a frequency of sixty cycles (per second). The frequency of the supply system is of fundamental importance in determining the speed of induction and synchronous motors.

6. Obviously, the reason the current alternates is that the voltage causing it to flow is alternating or reversing in direction. It is possible for the current to reverse in time with the voltage, or before it, or after it. In the first case the current is said to be in phase with the voltage; in the second case the current *leads* the voltage, and in the third case, the current *lags* behind the voltage.

If an alternating voltage is impressed across a pure resistance—such as an incandescent light, the current will be in phase with voltage.

If an alternating voltage is impressed across a condenser, the current will, after a few cycles, be found to lead the voltage, so that the current already reaches its maximum value just as the voltage is about to act in that direction in the circuit.

Lag and Lead

If an alternating voltage is impressed across a magnet coil (inductance), the current will, after a few cycles, be found to lag the voltage, so that the current is just starting to flow in the direction in which the voltage has already attained its maximum value.

If the circuit, into which the alternating voltage is impressed, consists of resistance as well as inductance or capacity, the current will not lag or lead, respectively, to the extent mentioned above, as the resistance tends to pull the current in phase with the voltage. Please note that the phase relation between the voltage and current has no bearing on the frequency. The current must alternate at the same frequency as the voltage that produces it, but the current may lag or lead the voltage in the series of events comprising each cycle, and thus be continually out of step with the potential by a certain fixed amount of time called the *phase angle.* An alternating current through a resistance is said, therefore, to have a phase angle with respect to the voltage of *zero* degrees; through a condenser, of 90 degrees leading, and through an inductance, of 90 degrees lagging. The conception of phase is very important in understanding the action of an induction motor.

Rotating Field

With the foregoing general remarks we are now in a position to study the operation of the induction motor.

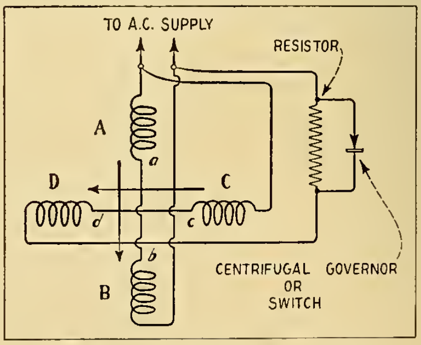


Fig. 2. Single Phase Winding

Suppose we have two sets of alternating supply mains, such that when the voltage in one system is at a maximum, that in the other is passing through its zero value (about to reverse its direction). Such two sets of mains are called a *two phase system;* the two voltages in the two phases have the same frequency, and maximum value, but are completely out of phase, i.e.—their phase angle is 90 degrees. Suppose we connect one phase (set of mains) to a pair of magnets "A" and "B," and the other phase to magnets "C" and "D" (Figure I). Note that "A" and "B" are situated in space at right angles to "C" and "D."

At some instant of time the current in "A" and "B" from phase No. 1 will be at a maximum in one direction, and will produce a magnetic field in the direction "a b" (Figure I). At that time, the current through "C" and "D" from phase No. 2 will be zero, hence the flux in this direction will be zero. Hence, at that moment, the only flux is that in the direction "a b." A quarter of a cycle later in time, the current through "A" and "B" will be zero and about to reverse, as will also, therefore, be the case with the flux. But by this time the current through "C" and "D" will have increased from its previous zero value to its maximum value, hence these magnets will produce their maximum value of flux in the direction "c d." To an external observer it appears that magnetic lines of force have turned from a vertical to a horizontal position during this quarter of a cycle.

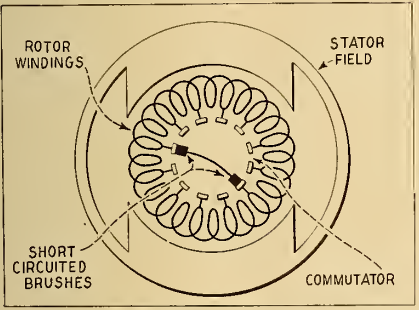


Fig. 3. Repulsion-Induction Motor

Reversal of Flux

A quarter of a cycle later in time, the current in "AB" is again at a maximum, *but now in the reverse direction,* and that in "CD" is zero. We now have a flux in the direction "*b a*" (which is opposite in direction to "*a b*"), or the flux appears to have turned through another quarter revolution.

Then, a quarter of a cycle later in time (or three-quarters of a cycle all told), the current in "AB" is zero, and that in "CD" is at a maximum *in a reverse direction,* so that the flux is now in direction "*dc,*" or it has turned another quarter of a revolution.

Completion of Cycle

Finally, at the end of the cycle, current in "AB" is again at a maximum in the same direction as originally, and that in "CD" is zero, so that we return to the original condition of flux in the direction "ab," or the flux has completed *one revolution,* and this in *one cycle.* Consequently, if the two phase supply has a frequency of *sixty cycles* (per second), the flux will apparently rotate at a speed of *sixty revolutions* per second.

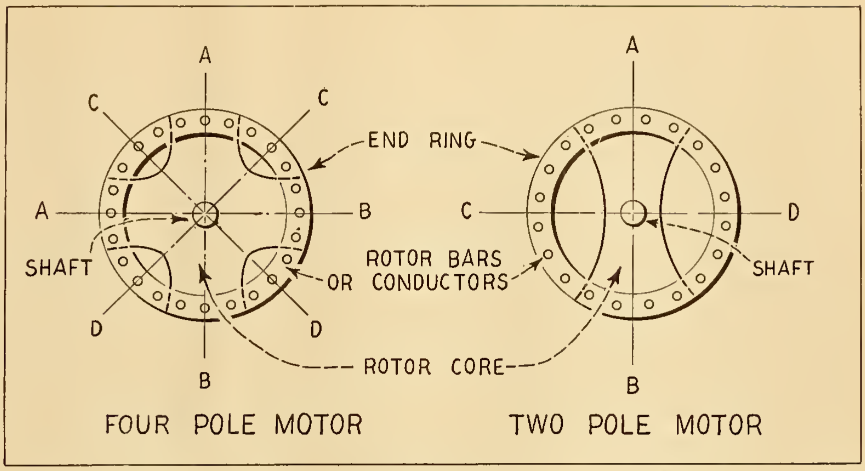


Fig. 4. Rotor Construction for Synchronous Motors

The above elementary description may give the reader the impression that the flux skips around in a jerky fashion—one-quarter revolution at a jump. However, the current in each phase varies smoothly throughout its cycle, and it can be shown mathematically that as a consequence the magnetic flux rotates smoothly and uniformly in the magnetic structure. The latter is the stationary part of the motor, i.e., the frame with the internal slots and windings that can be seen in any induction motor when disassembled.

This conception of a rotating field is the basis of the induction motor operation. While the description given above applies to a two phase supply, an exactly similar description applies to a three phase motor and supply. In this case the motor has three pairs of magnets instead of two—one pair for each phase.

A mechanical analogy to the rotating field caused by a two phase supply is a two cylinder gasoline engine, with the two cranks at right angles to each other. With proper timing, the two pistons will act on the crankshaft alternately every quarter of a revolution, and produce a uniform turning effort. For the case of a three phase supply, we may use as an analogy a three cylinder gasoline engine, with the cranks 120 degrees apart.

Action of Rotor

We have established above the existence of a rotating magnetic field in the stator of the motor. Suppose a series of wires be placed within the stator. As the magnetic flux rotates, it cuts these wires, and as stated in General Principles, generates a voltage in these wires. A current consequently flows in each wire, and this current reacts with the rotating field to produce a mechanical force. This force, it can be demonstrated, is in the direction of the rotating field, hence the wires tend to follow the field, and thus rotate in the stator. In a practical form, these wires are arranged in the form of a copper bar squirrel cage around the motor shaft (squirrel cage rotor), or in another form, an armature similar to that used in D.C. machines is employed, and ordinary insulated wire is wound in the slots and properly connected.

Induction Motor Operation

We are now in a position to study the characteristics of such a motor. If the rotor is free to rotate, a small amount of current is required to flow in its conductors in order to develop the small amount of force required to rotate it. This means that only a small amount of voltage need be generated in the conductors, so that the rotor will rotate at *nearly* the speed of the revolving magnetic field.

If now a mechanical load be imposed on the rotor, it will slow down, whereupon it *slips* behind the constant speed rotating field to a greater extent, a greater voltage is generated in it thereby and the greater current produced by this increased voltage develops a greater mechanical force or turning effort which balances the increased load. Thus the motor slows down the greater the load imposed on it.

However, in a well-designed induction motor the slip of the rotor behind the rotating field is small, that is, the rotor rotates for all normal loads at nearly synchronous speed. This is brought about by making the rotor winding or conductor bars of low resistance, so that a little voltage, requiring but a small slip behind synchronous speed, develops enough rotor current to produce sufficient torque for the loads encountered. The net result of all this is that an induction motor, while it does not rotate at constant speed for all loads, varies so little in its speed as to be perfectly satisfactory for driving a sound equipped projector, and the majority of sound reproducing equipments are equipped with this type of motor.

It has been demonstrated that the magnetic field rotates at synchronous speed, and that this is sixty revolutions per second, or 3600 R.P.M., for a sixty cycle supply. It has further been shown that the rotor slips behind the revolving field, so that it revolves at possibly 3500 R.P.M. Suppose a magnetic field speed of 1800 R.P.M., or rotor speed of 1750 R.P.M. is desired. Referring to Figure I, if we place just double the number of magnetic poles around the stator—in this case four more—the flux will make only one-half a revolution during one cycle and yet pass as many poles as it did before in one complete revolution. In this way, by a suitable choice of the number of poles, it is possible to obtain various speeds for the induction motor, although there is the limitation in that each speed is an integral multiple of the other, and no speeds in between can be obtained except through the use of high rotor slip, which means inefficient operation and large variation of speed with load.

Single Phase Motors

In the case of a single phase circuit we have but one set of mains. Referring to Figure I, suppose that we have only phase No. 1, feeding magnets "A" and "B." No rotating field will be obtained—only a pulsating field between "A" and "B," having during one-half cycle direction "ab," and during the next half cycle direction "ba." A rotor installed in such a stator will not start, since there is no *rotating* field for it to follow. This can, however, be obtained by providing in some way a current through a second set of poles "CD," which current is out of phase with that in "AB."

Referring once more to the paragraphs headed "Lag and Lead," the reader will note that the current through either set of magnets will lag the impressed voltage by nearly the maximum amount, or 90 degrees, that is, the current will not reach its maximum value in either direction until the voltage is about ready to reverse. If, now, we connect both "AB," and "CD" to phase No. 1 (since only one phase is supposed to be available) but, at the same time, insert a resistance in series with "CD," we shall find that, due to the resistance, the current in "CD" will not lag behind the voltage as much as that in "AB." (See Fig. 2.)

We have thus manufactured an inferior kind of two phase system, yet, nevertheless, one which will produce a rotating field in the stator. At different parts of the revolution the field strength will be different, so that it is called an *elliptically* rotating field, and its action is not as smooth as in the case of a true two phase system. It is now analogous to a two cylinder gasoline engine in which the two cranks are still at right angles, but the timing is not correct, so that the crankshaft tends to run somewhat jerkily.

Sufficient torque is obtained, however, in the case of the induction motor to start it under more than full load, and such split-phase induction motors are in very successful use today.

A New Phenomenon

Once the rotor is up to speed, a new phenomenon arises. The rotor currents now set up a magnetic field of their own at right angles to and 90 degrees out of phase with the main field produced by "AB," so that there is now no further need for the magnets "CD," especially since the resistance in their circuit wastes power. Consequently, a centrifugal switch is provided on the rotor for the purpose of automatically cutting out split phase "CD," when the rotor is nearly up to normal speed.

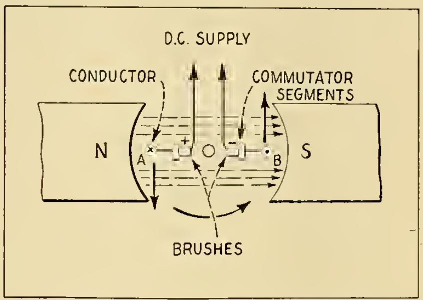


Fig. 5. D.C. Motor Diagram

There is another method of starting a single phase motor, called the repulsion method. In this case a fully wound rotor is used, and a commutator. Brushes bear against the latter at a certain angle to the field (Fig. 3), and are, moreover, all shorted together. Due to lack of space, the only explanation to be given here is that due to the angle between the brushes and the field (stator), part of the latter acts as the primary of a transformer to induce currents in the rotor (which is thus the secondary), and then the latter currents react with the other part of the stator field to produce rotation.

Motor Characteristics

This motor has the characteristics of a series motor, i.e., at low loads its speed is dangerously high and under heavy loads its speed is quite low. Hence, this repulsion connection is used to bring the rotor up to speed, whereupon a centrifugal switch acts to short out the commutator (and in some cases to raise the brushes from the commutator) and the rotor then becomes a squirrel cage rotor in principle, supplies the second phase, and thus keeps running at the practically constant speed desired.

Heretofore mention was made of the rotor only to the effect that it was composed of copper conductors suitably disposed about a shaft. Actually they are fitted into slots in a laminated circular steel drum mounted on the shaft. The function of the steel is to cut down the air path the magnetic flux must traverse in passing from one part (pole) of the stator to the other, since magnetism flows far more readily through steel or iron than through air.

In the ordinary induction motor this drum is perfectly circular, so that the air gap between it and the stator is the same at all points of its circumference. The magnetic flux, which, it will be remembered, travels at synchronous speed and hence a little faster than the rotor, finds it just as easy to pass through the rotor steel drum at one point of its circumference as at another.

If, however, we give this steel rotor drum the shape shown in Fig. 4, it will be evident that the flux will pass more readily through diameters "AB" than through "CD". Consequently, while such a machine will start as a straight induction motor, due to the squirrel cage, there will be super-imposed on the normal torque (turning effort) an additional torque due to the tendency for the rotating field to want to pass through line "AB". Hence the rotor will speed up until it is traveling at the same speed as the field (synchronous speed) and in such a position that the field is always passing through the rotor along "AB" rather than "CD". In short, the rotor locks magnetically into step with the revolving magnetic field and thereafter there is no slip between the rotor and the field.

Such a device is a synchronous motor (sometimes called a hysteresis motor), and technical men will recognize it as a synchronous motor running with an unexcited field, under which condition it draws a large lagging current from the supply mains to furnish the magnetic excitation normally supplied by direct current.

Function of Squirrel Cage

The function of the squirrel cage is to start the motor and also, after it locks into synchronism, to prevent hunting-oscillations of the rotor about its instantaneous mean position—as well as to prevent stalling if a great overload is suddenly applied.

Since ordinarily the line frequency is practically constant, the motor runs at practically constant speed and hence is eminently suited for projector drive requirements, particularly if polyphase power (more than one phase power) is available. It also finds application in television work for driving the scanning disc and in electric clocks.

D.C. Motors

While, from a projectionist's viewpoint, the direct current projector motor is not as important as the alternating current motor, nevertheless it is used in sufficient numbers to warrant its inclusion in this article.

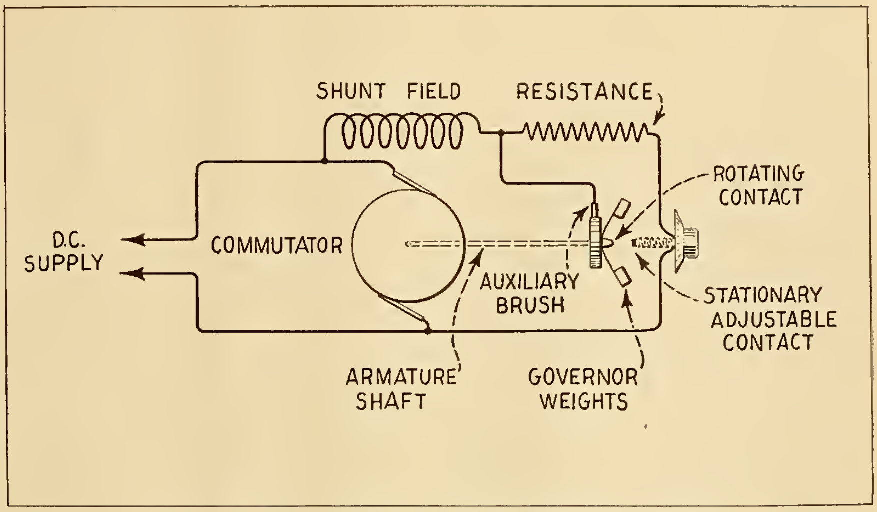


Fig. 6. D.C. Motor with Speed Control Switch

In Fig. 5 is shown a very elementary diagram of a direct current motor.

The horizontal arrows represent the lines of magnetic flux that stream across from the north pole of the stationary field magnet to the south pole. The armature consists of a laminated iron drum (not shown for the sake of clarity of the diagram), in order to permit the flux more easily to pass from the north to the south pole. In slots on this drum are placed copper conductors (wires) and these are suitably connected together. Let us consider one of these conductors situated at point "A" and connected to a commutator segment, as shown.

Commutator Construction

The commutator consists of an insulating cylinder on which are mounted segments of copper. Each segment is in the shape of an arc of a circle, each is insulated from the other, and each is connected to one of the conductors or to a group of conductors lying in one armature slot. Connections from the supply mains are made to the conductors through the commutator segments by means of brushes (sliding contacts), bearing against them as they pass by when the armature revolves. As shown in Figure 5, when the conductor is in position "A," the positive brush bears against its commutator segment and the current flows in the conductor in the direction into the paper. This current reacts with the magnetic field to produce a force downward, as shown by the vertical arrow. The armature assembly then rotates counterclockwise, as shown by the circular arrow.

Operating Principles

When a half revolution has been completed, the conductor will be in position "B". If the current still flowed in the same direction through it the force would still be downward, and since the conductor is now on the opposite side of the shaft the direction of rotation would now reverse. In other words, the armature would merely oscillate, rather than revolve continuously in one direction.

It is here that the commutator comes into play. Note now that the segment, being mounted rigidly on the same shaft as the conductor, has also moved to position "B" and is now contacting the negative brush. As a consequence the current through it and the conductor now reverses, and produces a force vertically upward, as shown by the arrow at "B". The direction of rotion is consequently still counterclockwise, and the armature completes its revolution and the conductor returns once more to point "A". Thereupon the same sequence of events takes place as before and the armature continues to rotate.

We must not, however, overlook the generator action that must simultaneously take place in the machine. The armature revolves because of the mechanical forces generated by the interaction of its current-carrying conductors and the magnetic field. These same conductors, however, in moving through the magnetic field, have a voltage induced in them.

This voltage is proportional to the speed of rotation of the armature and also the magnetic field strength, and is in direct opposition to the impressed line voltage which is forcing current through the armature. As a matter of fact the line voltage is equal and opposite to the sum of this generated counter electro-motive force (voltage) plus the resistance drop in the armature. (The latter voltage is very small in a well-designed machine, so that the counter voltage itself is nearly equal to the line voltage.)

It is this counter electro-motive force which limits the speed of rotation of the armature and is, as will be explained later, a means of maintaining constant speed for projector drive purposes through field control.

Action Under Load

The action of the motor under load is very much like that of the induction motor. The torque of the motor must always equal the mechanical load imposed on it in order that it keep running. This torque is proportional to the product of the current through the armature and the strength of the magnetic field. In a shunt motor the field is excited directly from the line, whose voltage is practically constant, hence the field is practically constant, too. Consequently the torque of the motor is directly proportional to the armature current itself.

If we impose a greater load on the motor its armature current must of necessity increase to develop the greater torque required. To do this the countervoltage in the armature must decrease in order to allow the line voltage to send a greater current into the armature. But, the counter voltage can only decrease if the armature speed decreases and this, fortunately, is the normal tendency of the machine when additional load is imposed on it. Hence the action of the motor is entirely automatic: as more load is placed on it, its speed decreases sufficiently (usually a small amount), a greater current flows into it, and it is thus able to carry the increased load. Note how much simpler this is than a steam or gasoline engine, which requires a special valve or governor for the purpose of feeding more steam or fuel to the engine as more load is placed on it.

As has just been explained, if the armature resistance is low the ohmic drop in it is low and practically all of the line voltage is used to overcome the generated countervoltage. Or, to put it the other way around, the counter electro-motive force (usually denoted as C.E.M.F.) is approximately equal to the line voltage. Now the latter is always maintained constant, hence the C.E.M.F. is constant, too. But the C.E.M.F. is equal to the product of the speed times the magnetic field strength. As mentioned before, in a shunt motor the latter is constant, so that we arrive finally at the result that since the line voltage and field strength are constant, the C.E.M.F. and consequently, the speed, are constant, too.

Speed Control

But suppose we decrease the field strength. In order for the C.E.M.F. to remain constant and approximately equal to the line voltage, it is necessary for the speed to increase. Hence, in a shunt motor, if we wish to *increase the speed, we weaken the field.* This is done by inserting a resistance in series with the field coils, thus decreasing the current through the latter.

We now perceive how the shunt motor may be made to maintain constant speed even if the load or line voltage varies. Thus, suppose that a resistance is connected in series with the field coils, and a centrifugal switch or governor is connected across the resistor (see Fig. 6).

If the centrifugal switch short-cir-

(*Continued on page* 40)

Lenses: Further Considerations

By LLOYD E. HARDING

In our December issue the author of the present article presented an outline of the fundamental principles underlying simple lenses. Mr. Harding, in the article which follows, continues the discussion with a consideration of several phases of the subject, which, because of lack of space, he was unable to give his attention in our previous issue.—EDITOR.

ONE of the best ways to understand the action of a lens on light is to visualize the light as being in the form of a wave front. In a previous article it was said that glass is a denser material than air and that when a wave front of light strikes a denser material it is held back or retarded in speed.

Let us observe, then, the effect on a wave front of a simple lens such as the double convex lens which is familiar to you as a type of condenser lens used extensively in arc lamphouses.

Radiation of Light

Light from any single source, such as an arc, radiates outward in circles, this being shown in Fig. 1-A, where L is the source of light and where the light waves are seen as numerous concentric circles around the source L. Only half the complete circle is shown. The straight arrows extending outward from the center show the direction in which the light rays are traveling in a particular section of the wave front.

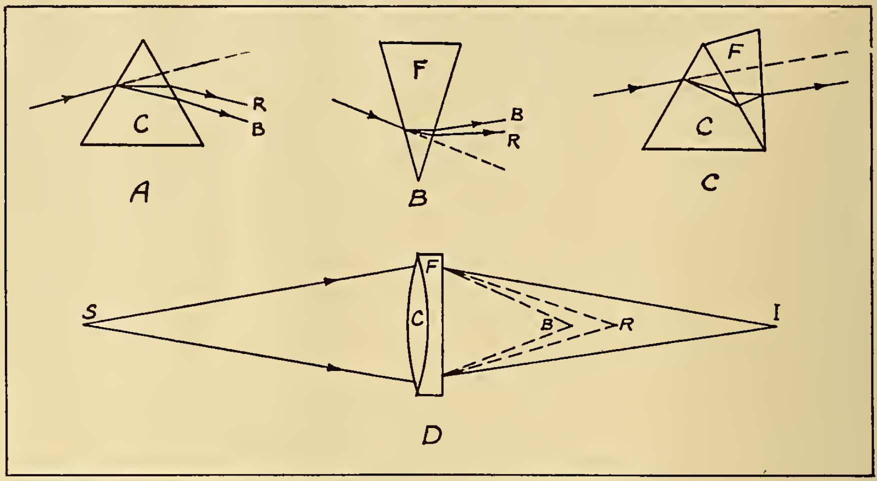


Fig. 2. Aberration and Its Correction

Let us now (Fig. 1-B) place a glass lens G in the path of the light rays so that a section of the circular wave front strikes upon the lens and passes through. It is seen that the wave front from the source of light L has been so changed by its passage through the lens G, that instead of spreading outward in ever-widening circles it has been reversed in form and tends to compress the wave front into smaller and smaller circles until all the light passing through the lens is concentrated in a spot at F. It is apparent that when this takes place the spot of light at F is an exact image of the source of light L.

Changes Wave Front

When we remember that the speed of light is less in glass than in air, it is easy to see how a lens of this type (thicker in the middle than at the edges) changes the shape of the wave front, so that although the wave front is diverging (spreading) before it passes through the lens, it is converging (growing smaller) after it passes through the lens.

The action of such a lens is that the central portion of it, being thicker than the edges, holds back the part of the wave front passing through the thicker part while the portion of the wave front which passes through the edges of the lens is held back very little. In the example shown (Fig. 1-B) the central part of the wave leads the ends before it reaches the lens but after passing through the lens the ends are farther ahead than the central part of the wave.

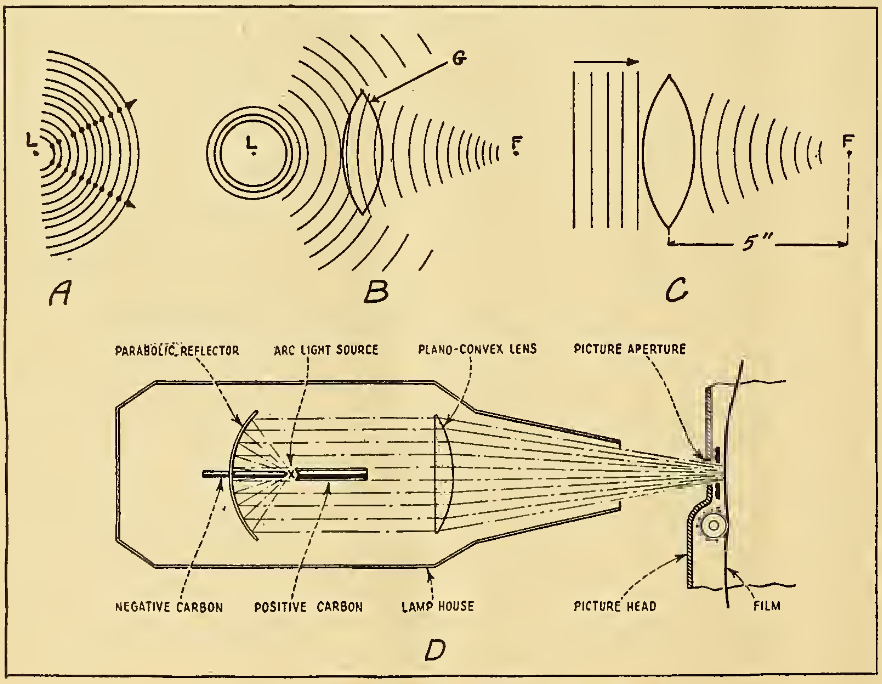


Fig. 1. Lens and Reflector Principles

Focal Length

A lens is designed so that it may have a certain desired "focal length," that is, so that the image or focus F is a certain distance from the center of the lens under certain conditions.

The focal length of a converging lens is that distance from its center at which parallel rays of light gathered by the lens are focused to a sharp image. This is illustrated by referring to Fig. 1-C where parallel rays (straight vertical lines) from a distant source of light are brought to a focus at a point say 5 inches from the center of the lens. The focal length of such a lens is said to be 5 inches.

The Parabolic Reflector

There are other ways of producing parallel rays of light besides that of having the light source at a great distance. One of these methods is to gather the curved rays from a light source by means of a parabolic reflector which changes the wave front from a curved to a straight one.

This is more easily visualized by reference to Fig. 1-D, which is a schematic view of the course taken by light rays from the arc in such a type of lamp as the peerless reflector arc. In this illustration a plano-convex type lens is shown which acts similarly to a double convex lens in converging the wave front to a focus. In this case the focal length of the lens is the distance from its center to a point in the picture head where an image of the arc crater is formed.

Another method of producing parallel beams of light is by using a lens, for it is easily seen that if, in Fig. 1-C, a light source were placed at F then the wave front would be flattened out on passing through the lens until when it emerged from the lens it would consist of parallel beams of light or in other words the wave front would be a straight one.

Arc Reflector Practice

In reference to Fig. 1-D it might be mentioned that the image of the crater is not brought to a focus at the aperture because it would be too small to cover completely the aperture. We know that it is necessary to cover completely the aperture with light in order that the whole screen picture may be evenly illuminated.

Therefore the beam of light in the lamp is so adjusted that it is out of focus at the aperture, which results in a fairly even spot of light covering the aperture with a small circle of light striking the cooling plate around the aperture.

You have probably observed that it is necessary to have this circle of light which strikes the cooling plate a bit larger than just the right size to cover the aperture. This additional light striking the cooling plate does no useful work and, what is worse, it adds considerably to the heat of the plate and aperture, increasing the fire hazard and wasting electric current.

Spot Considerations

Why then is not the light focused to a smaller spot so that it just covers the aperture to its edges and thus do away with the undesirable features of heat and current waste mentioned above?

The answer lies in the fact that any simple or uncorrected lens, such as the condenser lens, is subject to two troubles. It *does not* bring the rays of light passing through its edge to a true focus with rays passing through the center and it *does* separate the white light which passes through the edge of the lens into the various colors which go to make up white light.

Kinds of Aberration

The first of these troubles is known as "spherical aberration" and the second is called "chromatic aberration." The word "aberration," while it sounds difficult, means nothing but a "wandering" or "deviation."

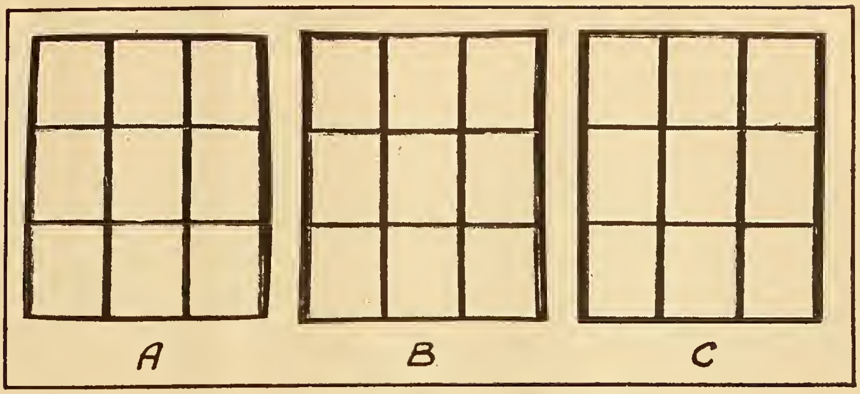


Fig. 3. Astigmatism and Its Correction

In the case of spherical aberration it means simply that all the rays of light passing through the lens do not come to a focus at a single point but "wander" a bit, while chromatic aberration means that all the colors, of which white light is composed, are not brought to a focus at a single point but they too "wander."

How Recognized

We know that a lens produces spherical aberration when we find it impossible to produce a sharp image of a light source, the image instead having a "fuzzy" out-of-focus appearance.

The indication of chromatic aberration in a lens is that a "rainbow" of color is seen around the white center of the image. This, then, explains why it is necessary to waste the edges of a "spot" on the aperture plate for we wish to prevent the colored light in the edge of the spot from passing through the aperture to the screen. What we do literally is to cut the white center out of the beam and pass it through the film to the screen.

This procedure is fairly satisfactory in regard to the condenser lens but you may very well wonder why it is that the same trouble is not experienced with the light beam as it passes through the projection lens in the picture head. If chromatic aberration occurred in this lens we would be distinctly "up against it" for there would be no opportunity to cut the white center out of the beam and project only this to the screen. To do this would result in only the center of the film picture showing on the screen while the corners would be in darkness.

Lens Correction

The answer is that a projection lens differs from the condenser lens in this respect: the projection lens is a "corrected" lens while the condenser lens is an "uncorrected" lens.

The corrected lens has the ability to focus all the colors found in white light to a single point in the image so that when all the colors "land" on the same point they mix and form white light again. The condenser lens, which is uncorrected, is made of a single piece of a certain kind of glass while the corrected lens, such as a projection lens, is made of a combination of two kinds of glass known as crown glass and flint glass.

The Explanation

Fig. 2-A-B and C explains how the combination of two kinds of glass corrects chromatic aberration. "A" in Fig. 2-A represents a prism of crown glass "C" with a ray of white light L passing through it from the left. Let us remember that this prism represents a rough idea of the upper half of a double convex lens as seen in edgewise view.

The ray is refracted downward but the red part of the ray (R) is refracted or bent less than the blue part of the ray B. The red and blue parts of the ray therefore come to a focus a certain distance from each other and show up on a screen, if one is placed in the path of the light, as two separate bands of color with the space between them filled up with bands of the other colors which go to make up the white light of the original beam. In effect a small rainbow of colors would appear on the screen running from red through orange, yellow, and green, to blue at the lower edge.

Effect of Flint Glass

Let us now substitute the prism of flint glass F (Fig. 2-B) for the prism of crown glass in Fig. 2-A. It is seen that the opposite effect is produced by this prism so that the blue light is placed above the red light, exactly opposite to the condition brought about in "A." Now by joining the two prisms as shown in Fig. 2-C, they "correct" each other so that the blue and red light rays are joined and brought to a focus at a single point. As was mentioned before, this results in white light at the image.

Fig. 2-D serves to make this clearer. Light from the source S passes through the corrected lens made of crown glass C and flint glass F and is brought to a focus in an image of white light at I. The dotted lines B and R show where the blue and red portions of the source light would have come to separate foci if the lens were an uncorrected one.

(*Continued on page* 22)

Painting the Silver Sheet

By JOHN L. CASS

Part II: Photographic Methods

Color has been referred to by Mr. John I. Crabtree, retired president of the S.M.P.E., as the only immediately available variant from the prevailing black and white picture, and its further development is anticipated by leaders of the Industry as the next outstanding technical achievement. The following article from the pen of Mr. John L. Cass, assistant chief engineer of RCA Photophone, marks the second of a series to be contributed by the author on this important subject. Mr. Cass is particularly qualified to discuss the application of color in motion picture scicnce, his engineering experience having embraced many years of research in the color picture field.—THE EDITOR.

NUMEROUS methods have been proposed for obtaining negative color separations in motion picture work. In the work which had been previously done in still pictures in color, the various cameras had similar characteristics. It was good practice to use a single lens, splitting the light from the lens through prisms and mirrors into two or three identical images, interposing color filters in the several beams, and exposing the negative images separately but simultaneously. The difficulty in applying this method to motion pictures was in securing sufficient exposure in the short interval available. In still picture work, the exposure was prolonged to compensate for the loss of light in the beam splitter, but this proved impractical in cinematography.

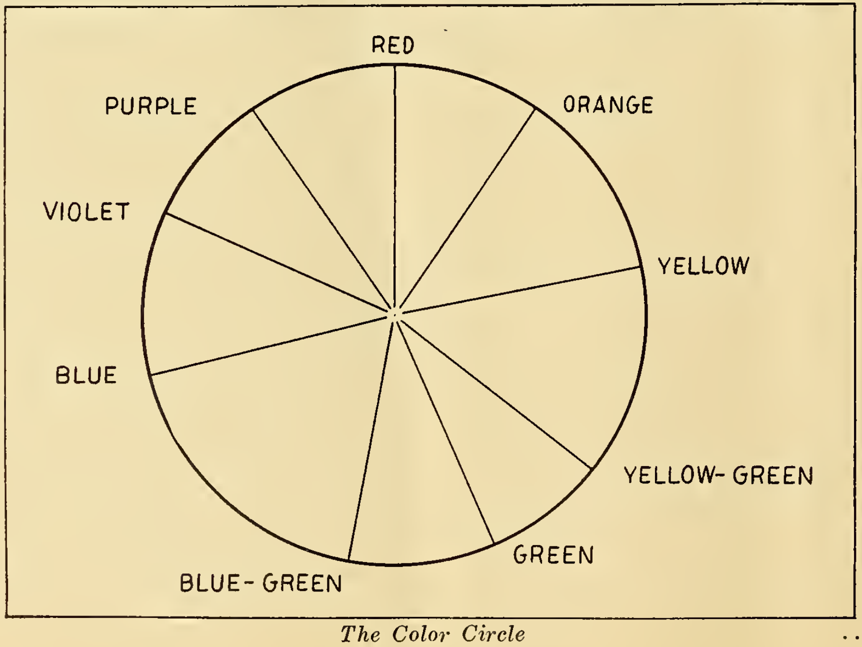
Several expedients were resorted to, the best known being the utilization of the persistence of vision in color projection. With this as a goal, the color negatives were made in a camera of the conventional type, to which was added a rotating shutter which introduced successive color filters in successive frames. Projection was accomplished in a similar manner, a color shutter being added to the projection machine.

Disadvantages of System

There were several drawbacks to the successive system as described. First of all, it was not adaptable to rapid motion, and was at its best when the scene being photographed was absolutely still. This defect originated in the change in position, with motion, from one color register to the next. When reproduced, such a negative results in what is known as "action fringing," a moving object appearing in its vivid color components rather than blended.

This defect is quite well known, and is always present to some degree when the negative separations are made by this method. High rates of speed have been used to minimize fringing, but further difficulties in projection have been encountered. In a previous article, the importance of standard handling in the theatre was brought out. This factor caused the special projection methods to be dropped in this case, the negatives being used later to produce two-color prints of a more conventional type.

As a result of this early work, certain criteria were established as representing the ideal condition in color cinematography. A camera should produce color separations which are made simultaneously, and from the same point of view. If made simultaneously, the negative images will represent the same aspect, or position, and will produce no action fringing when used for reproduction. If from the same point of view, there will be no parallax present in the print.



The Color Circle

Parallax Defined

Parallax is the condition which is best illustrated in stereoscopic photography, where the right eye picture differs from the left eye picture, and is responsible for the true depth effect obtained in the parlor stereoscope. In color photography, this difference constitutes a serious defect, and is usually present when a two lens camera is employed. Unless the point of view is identical in the color registers, the resulting positives can never be made to register properly throughout.

There are two methods of real importance in the professional field today, both of which meet the requirements stated above. One of these methods is the beam splitter used by Technicolor, the other is the bi-pack method, used by practically all other processes in the color field today. Both methods are used in producing two-color separations, of the orange-red and blue-green variety.

The Bi-pack Method

The bi-pack method, due to its simplicity, is of great interest to the film industry today. With minor alterations a standard camera answers the purpose for bi-pack. The mechanical difficulties are so few that any competent camera man may learn bi-pack technic in a relatively short time. It is interesting to note that the bi-pack method is not new. In fact, it is of such an age that it is essentially patent free at the present time.

For years the bi-pack method was considered interesting, but impractical, due to shortcomings in available emulsions. The rapid development of faster and better emulsions in the past few years is common knowledge. This progress in the art of film manufacture has made bi-pack a most practical method, due to the improvements in film speed and color sensitivity.

In the bi-pack camera, two films are used in place of one. The two films are run through the gate together, with the emulsion sides in intimate contact. To express it simply, the films are face to face in the gate, the celluloid side of the front film facing the lens. Optically the camera is unchanged from black and white usage, except of course the lens must be fast and of good quality. The clearance in the gate must be increased to allow the passage of the double thickness, eleven thousandths of an inch in place of the usual five and one-half.

A camera movement which embodies registry pins must be used, and care must be taken that the pressure plate presses on the film accurately. Standard camera magazines may be employed for ordinary length scenes, but special magazines are preferable. The special magazines contain two feed spindles, and two take-up spindles, thus insuring the snug handling of both raw stocks throughout the camera.

The Films Used

The rear film in bi-pack is nothing more nor less than a good fast panchromatic emulsion, which will register all light which strikes it, regardless of color. The front film is a special emulsion which serves three purposes. The front film is sensitive only to blue and blue-green, and is relatively translucent. On the surface of the emulsion is placed a filter layer of an orange-red hue. In operation, the light from the lens strikes the celluloid of the front film, through which it passes without alteration. Next the light strikes the blue-green sensitive emulsion, which records the colors of that end of the spectrum.

The red light does not affect the front emulsion, for the same reason that reds did not photograph in the pre-panchromatic era. After passing through the semi-transparent front film, the remainder of the light is filtered by the orange-red layer, the red light which passes being registered on the rear film. There is usually incorporated in the lens system a filter which reduces the amount of blue light entering the camera, because the actinic value of blue light is so high that it would tend to overpower the other sections of the spectrum.

The lens is adjusted so that the focussed image falls at the plane in which the two emulsions are in contact. From the foregoing description it is evident that the two color registers are identical in every respect except as to the portions of the spectrum registered. Thus the requirements as to point of view and simultaneous exposure are met.

The quality of image obtainable by this method is quite acceptable, and is improving rapidly through the invaluable laboratory of constant use. The two images have an opposite relationship when separated, which is a fortunate coincidence from the standpoint of the several processes by which prints are being made. Further mention of this relationship will be made in a later article covering such processes.

Another advantage of the bi-pack method is that the two color registers may be given different treatment in negative development. This feature is of particular value where the positive process used is such that the corresponding positive images must be developed simultaneously. The contrast obtainable from exposure to various colors is in itself variable, so that separate negatives offer an easy adjustment point.

The Technicolor Method

In the Technicolor camera, the requirements as to point of view and simultaneous exposure are also met. This is a patented arrangement, and is not available for general use except on a contractual basis with that company. One lens is employed, the beam being split in a reflecting prism before reaching the film. The prism used contains a combination reflecting-transmitting surface, which constitutes the splitting point.

The prisms are so arranged that the resulting images are alike except in color representation, and are disposed in a vertical arrangement, one of the images being tipped upright. The resulting images are "feet to feet," and are in immediate juxtaposition. One film is used, but is moved two frames after each exposure, the resulting negative being twice as long as normal black and white, the images in pairs. The separation color filters are placed immediately before the film, and produce about the same division of the spectrum as in bi-pack. The methods used in producing prints from this negative will also be discussed in a later article, although there is no inherent difference between these negative images and those produced by the bi-pack method.

It is generally felt that the negative images produced by the Technicolor method are somewhat sharper than in bi-pack, although there are vigorous proponents and opponents of both systems. The Technicolor method does not have the advantage of separate control of development, since both color registers are on the same piece of film, and must necessarily have the same treatment. Similarly, the problem of color sensitization is more difficult, since the proper characteristics for all colors must be incorporated in a single emulsion.

The Brewster Method

There is one other camera which appears to have many of the advantages of both systems, even though it has not been used to any great extent commercially. The camera referred to is that developed by Mr. P. D. Brewster, and used with the process of the same name. In the Brewster camera, one lens is employed, the splitting being accomplished by means of a rotating reflecting shutter of several blades. This moving reflector is positioned at forty-five degrees with the optical axis, in front of one of the negative films which occupies the normal black and white position.

During the exposure interval, a number of blades cut across the light beam, reflecting it at ninety degrees to a second negative. This second negative is at ninety degrees with the first negative, and is entirely separate. The action of this arrangement is such that each negative is subjected to a series of short exposures while the main camera shutter is open. These short exposures integrate to produce images which may be considered as identical, although there is actually an infinitesimal time difference present.

The outstanding advantage of the Brewster method is the simplicity of the optical path. The negative which occupies the normal position obtains light which has been subjected to no distorting influences except a flat gelatine filter. The other negative receives an image from a first surface mirror, admittedly the least distorting member of the optical family. The advantage of separate negatives is again apparent.

The mechanical difficulties in the Brewster and Technicolor camera, in the opinion of the writer, are much greater than in bi-pack or black and white, but are not insurmountable. All three methods produce negatives in two color which are representative of the best practice in the art. There are many other camera methods, but none has come to the attention of the writer which answers the requirements stated earlier. The three color possibilities of these methods will be discussed at a later date.

(To be continued)

British Kinematograph Society Endorses Film Treatment

The Technical Committee of the British Kinematograph Society, in response to the many requests received from the English film trade, has recently investigated the effect of preservative treatment of motion picture film. The findings of the Committee are essentially as follows:

"Treatment of the film by preservative solution should not in any way act detrimentally to the production of sound, and should not add any ground noise, provided (*a*) the solution used is homogeneous when dried, absolutely transparent and dries evenly and not in waves; (*b*) that the coating in question is flexible, completely adherent, and will not, in use, develop minute cracks owing to flexure in passing over the sprockets and through the gates; and will not be affected by the heat of the arc; (*c*) that the surface of the preservative coating is not liable to deterioration or scratching under oil or moisture."

Kalee Projectors Becoming Popular in France

Thirty-seven installations of Kalee all-British projection machines have been made in France since Cine Theatre Installations, a subsidiary of E. A. Langrish Co., Ltd., of Great Britain, began operating in France. The 37 installations comprise 74 Kalee machines. The first Kalee apparatus was installed last January.

Modern Effect Lighting

By J. H. KURLANDER

To light, with its manifold gradations, color, form and movement, obtainable through the use of modern effect projection equipment, belongs the credit for some of the most attractive illusions of the present day stage. In the ensuing article Mr. Kurlander describes some simple methods for securing pleasing and interesting color combinations and effects and offers suggestions for the attainment of unusual, bizarre and striking lighting. The author was formerly connected with the Brenkert Light Projection Company. He is now associated with the Westinghouse Lamp Company and is Secretary of the Society of Motion Picture Engineers.—THE EDITOR.

MOTION picture exhibitors have for the past several years been endeavoring to provide a proper setting for the motion picture which would not only lend atmosphere to the program but would also possess entertainment value in itself. Progress in this branch of theatre entertainment has been retarded for two principal reasons: First, a general lack of suitable equipment with which to obtain the special adjustments required for this kind of work and, second, a lack of knowledge on the part of the theatre staff as to exact procedure in the creation of appropriate effects.

Until recent years all the equipment available for producing special lighting effects was rather cumbersome and strictly limited in its application. None of the so-called effect projectors had been designed expressly for the purpose of creating lighting effects, being more on the order of the lantern slide projectors with a few wrinkles added to permit the projection of a limited number of effects.

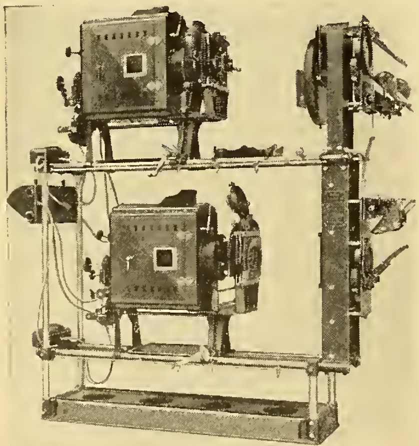


Fig. 1. Universal Effect Projector

The arduous labor required for the manipulation of these projectors, coupled with the projectionist's lack of specific knowledge as to how to create effect settings, was sufficient to keep the art at a virtual standstill except in isolated cases where the projectionist was possessed of sufficient enterprise and perseverance to overcome the obstacles confronting him.

The work of continually creating effect lighting settings in advance of the feature picture showing is sufficient to keep the projection staff busily engaged without absorbing part of their time and diverting their energies to the task of adjusting the projector.

The threatened displacement of orchestras and stage presentations as a result of the widespread installation of sound equipment and the liberal supply of sound shorts and novelties makes it necessary for the theatre owner and manager to consider other means for providing an entertaining atmosphere to relieve the straight picture show of the danger of monotony.

One method of accomplishing this objective is through the medium of effect lighting. The wide variety of subjects which lend themselves to exploitation and the consistent economy with which they can be obtained makes the consideration of effect settings of great importance to the theatre contemplating a straight sound picture program.

General Procedure

In general, scenic effects are imaged upon a suitable curtain, drop or scrim, by the simple expedient of placing a revolving transparent disc, on which the particular effect is painted, printed or photographed, before a projection lens, much in the same fashion that a slide is projected by a stereopticon lantern. Many of the commonly used effects are nothing more than special, elaborate lantern slides so designed as to repeat themselves continuously upon the screen. The driving power for these effects may be obtained from a double-spring clock-work motor or an electric motor, attached to the metal casing which encloses the revolving disc.

In order to facilitate a more extensive incorporation of effect settings in the program, all adjustments of the projector, shown in Figure 1, are of the pre-set type. In other words, the projectionist, when working out the effect schedule for the following week, adjusts the several working parts of the machine to give the desired results on the stage, or wherever the effects are to be shown.

The various shutters, framing devices, masks, effect holders, etc., are locked into their proper adjustments and are then removed from the projector for future use. Focusing indicators are provided for each of the four projection lenses used with each of the two projection systems. These lenses are mounted in a vertical swivel assembly and are graded as to focal length as follows:

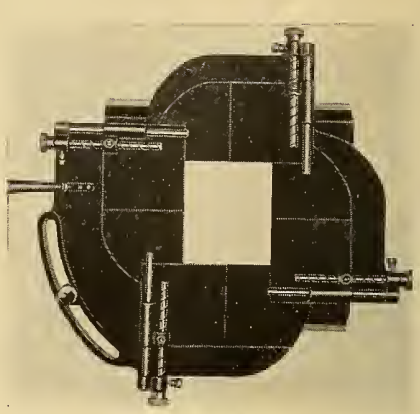


Fig. 2. Pre-set Adjustable Aperture Mask

Grading of Lenses

A short focal length lens (about 14 inches) is used for exactly covering the entire width of the stage opening; the second lens is used for filling the picture screen when a slide with a standard matt opening is projected; the next lens is of somewhat longer focal length so that it will also fill the picture screen when a special slide with a non-standard, and larger, matt opening is projected; and the fourth lens has a focal length of between 30 and 40 inches for special effect and spotlighting work. Focusing is accomplished by sliding the lamphouses back and forth by means of a hand-operated gear engaged in a rack.

A departure from old methods in the manner of controlling the light beam is employed. The last element in each of the two projecting systems is a set of three directional mirrors, one of which is stationary and the remaining two movable, vertically, horizontally and crosswise, with respect to the projection axes.

It is unnecessary to move the machine as the beams are directed at will by manipulating two mirrors, each of which can be adjusted separately and locked into position so that it is possible to show two separate effects successively with each projecting system. Two sets of double effects can be shown by using the entire machine.

Flexibility in the projection of effects demands that the various shutters, framing devices and effect holders be independent of one another and so constructed that they can be locked into adjustment and then removed from the projector until they are used. A pre-set adjustable aperture mask is shown in Figure 2.

It is common practice in theatres to image effects upon a special screen set aside for this work. This practice should be adopted for best results. The screen commonly used is a scrim (an open mesh cloth similar to mosquito netting) of either white cotton, or metallic cloth (silver or gold) which is "flyed" to permit its ready removal. Metallic silver or gold cloth scrims reveal the effects in a beautiful manner but are not so serviceable as the plain white type because of their tarnishing properties.

The scrim is made large enough to cover the entire stage opening and the projection results are the same as obtained with an ordinary opaque screen, although of lesser brightness. A principal advantage of the scrim, aside from its low cost, is that effects can be projected upon it from the front (house side) at the same time that illuminated stage sets can be rendered visible through it when the stage lights are brought up.

If a pair of light-colored draw curtains are closed about three to six feet behind the scrim, the effect scene will be projected partly upon the scrim and partly upon the draw curtains. The resultant effect is a scene which has a remarkable appearance of depth.

The Alternative

A pair of light gray velvet, or steel gray metallic cloth draw curtains may be used as an alternative to the scrim. Colored effect scenes projected upon such curtains are very pretty indeed, but inasmuch as these curtains are usually suspended in vertical folds the projected scenes are obscured somewhat except for the balcony seats, from which position the effect is revealed in better form. If the curtain folds are too heavy and deep, the side seats and those close up will be at a disadvantage due to the shadows cast by the folds.

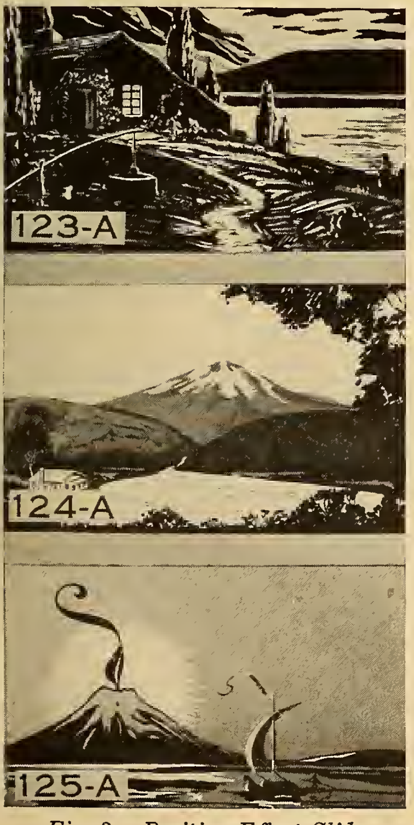


Fig. 3. Positive Effect Slide

It is not at all uncommon for theatres to use both scrim and draw curtains for effect work over the entire stage opening, as great flexibility is thus obtained. Some effects, especially those portraying woodland scenes, are better projected upon draw curtains because the ripples of the curtain folds lend themselves, in this instance, to accentuating the illusion of depth.

For projecting color effects, as a border around the motion picture, the picture screen is mounted in a field of light gray velvet, drawn taut and of a size sufficient to cover the entire stage opening. Effect scenes and blending colors can also be projected onto the picture screen to serve as a background for titles.

Effects Require Care

The projection of lighting effects is not such a simple matter that successful effects can be produced on the spur of the moment. Careful planning is necessary and a complete rehearsal of the entire program in which the effects are incorporated should be conducted.

To facilitate smooth operation and to avoid mistakes, a suitable cue sheet should be devised on which are marked the projector adjustments, effect settings, starting and finishing cues, etc.

Effect lighting embraces a multitude of opportunities for working out original ideas and is therefore free from the monotony which results from repetition. The three broad divisions of effect lighting are as follows:

1. Blending colors; projected by means of a revolving color wheel and special glass design slides.
2. Animated scenic effects; employing the standard drum type of motor-driven effect disc.
3. Effect scenes on slides and simple silhouettes.

The blending colors effect has long been used but the theatres seem never to tire of it, as very pleasing results can be obtained if the effect is properly presented. It has the advantage of being quite inexpensive although the number of design glasses available for this work has been limited.

Molded Design Glasses

Specially molded design glasses having patterns expressly intended for effect work have recently become available, however, so that new impetus should be given to this branch of the work. For best results the pattern should consist of a series of convex impressions so that the design stands in relief. Glasses in which the design has been cut into the glass proved to be unsatisfactory because the resulting prism action dispersed the light passing through the design and caused it to be projected in silhouette form.

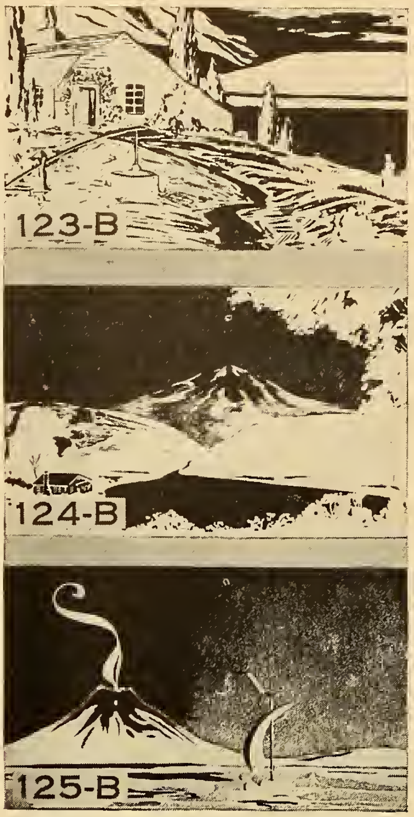


Fig. 4. Negative Effect Slide

Animated scenic effects can be used either alone or to provide local action to some part of a stage scene projected from the projection room. Thus, during an orchestral rendition of the Overture of 1812, a flame effect is projected over the entire stage opening to assist in the interpretation of that part of the music which portrays the burning of Moscow.

Simple lantern slides can be used to assist the action of a moving effect, an example being the projection of a moving cloud effect over the stage opening with a still picture of an airplane shown in the center. The movement of the clouds toward the airplane makes it appear as though the plane were really flying through the clouds. More elaborate effects of this type can be produced by projecting a still scene, colored by placing a gelatin filter in the light beam, over the entire stage opening, after which local action is supplied by the animated effect.

Projection of Stills

Without doubt the greatest and richest field of effect lighting is to be found in the projection of still effect scenes so designed and executed as to obtain trick effects that are at the same time pleasing and mystifying. These scenes are first carefully drawn to a large scale and

(*Continued on page* 29)

Projection on the High Seas

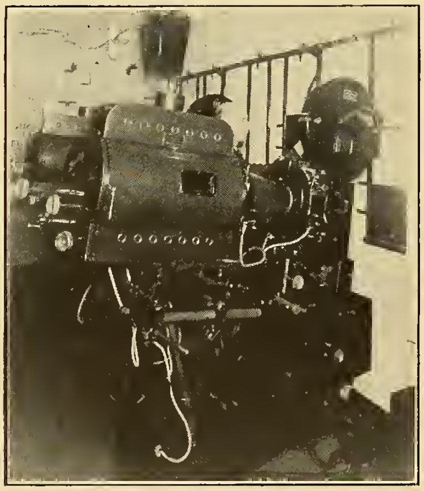
It is not unusual in this modern age for the projection room to go to sea; the fact of the matter is that its seafaring propensities were not unknown even back in the days of silent projection. One of the most salient features of the installation described in the following paragraphs is, however, that a great steamship company has recognized to such a degree the increasing importance of motion picture entertainment as a factor in ocean travel that it has included the motion picture theatre as an integral part of modern ship design.—THE EDITOR.

STEAMSHIP sound system installations have been made before, and have even traveled around the world; but the installation on the new Furness liner *Monarch of Bermuda* attains distinction for two specific reasons. One is that talking pictures on this latest greyhound of the Furness fleet were provided for, for the first time in shipbuilding history, as part of the original design even before the building of the ship was started. The second is that the plans of the installation included special safeguards against obstacles to perfect reproduction that might be raised by stormy weather.

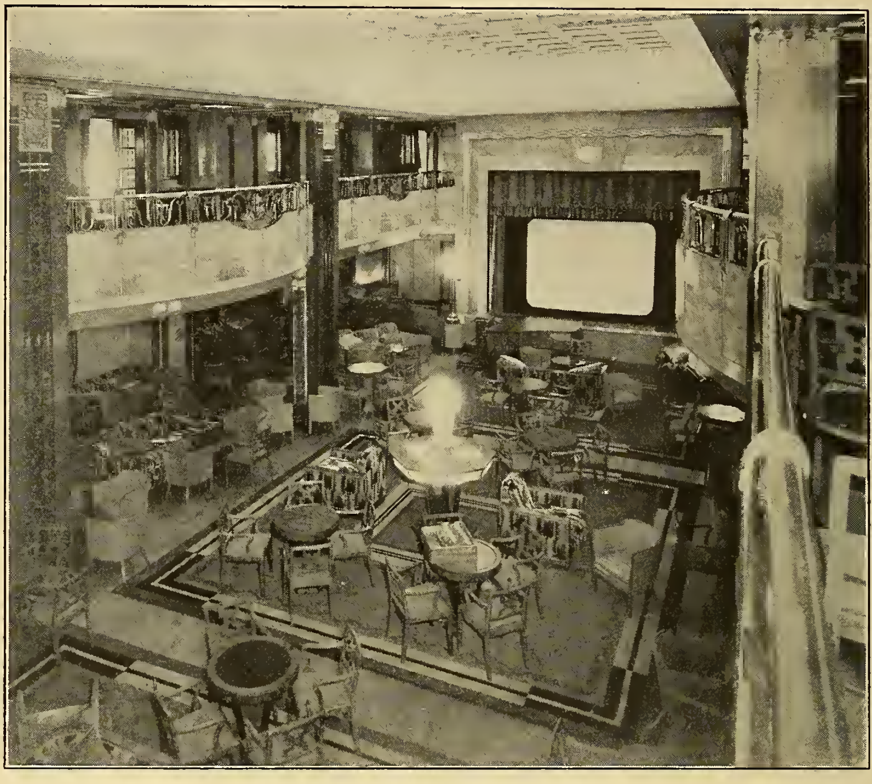
The fact that it was possible to plan for the installation before construction is hailed by Electrical Research Products' engineers as a tribute to the cooperation between their New York and London offices, inasmuch as the *Monarch of Bermuda* followed Furness precedent in having been built in England.

Installation Made at N. Y.

When the ship arrived in New York, prior to its maiden voyage to Bermuda, the installation of the wiring, the drilling and tapping of the decks and bulkheads and the placing of screws had been planned ahead with such foresight and executed with such precision, that the actual installation of the equipment in New York proved to be a relatively simple matter.



The Projection Room



The Theatre Showing Screen

The theatre is in the Brummel Room on the Sun Deck. In daytime it is a luxurious lounge room. The screen is concealed by draperies, the horns are shut off from sight, and the projection room, on the balcony level overlooking the hall, is invisible by reason of a beautiful fan-shaped mirror which conceals even the projection ports.

When shows are given this picture changes. The curtains part, the fan-shaped mirror is telescoped to clear the path of the projection to the screen and, as the lights dim, the picture is flashed on. Approximately 600 people are provided for in the seating capacity of the room.

For stormy weather special precautions have been taken. The horn in back of the screen is lashed to flush fittings on the stage. It is furthermore mounted on a cradle with special free rolling casters so that, should a stage performance ever be held there, it can be moved out of the way simply by opening up the cyclorama, which is constructed in sections and rides on rollers in a groove in the stage. There is a space of about two feet behind this cyclorama, just enough to store the horn when it is not in use.

The horn itself is of the shallow, high quality reproduction type, such as is used in many theatres of limited space, a consideration that entered markedly into its design.

Part of the success that has attended the camouflaging of the projection room lies in the fact that that part of the lounge room which it overhangs has been made into a comfortable fireplace nook, an ideal resting place for relaxing passengers.

Exact measurements had to be adhered to in designing this projection room, for the space available is far smaller than that used for the ordinary theatre projection booth. There are two Western Electric Universal base sound projectors with Simplex projection heads.

The keynote of the installation has been rigid economy of space and the result has, of necessity, been a compact and orderly arrangement of equipment and a neatness of operation that could well serve as a model anywhere.

Ventilation and Fire Control

The stage control equipment, the fire shutters and the ventilation system have all been placed so that they can be operated with the same precision and dispatch essential in the handling of the ship's navigating equipment.

The parallel is further borne out

(*Continued on page* 39)

S. M. P. E. Hears New Disc

Impressive Demonstration Staged at New York

In view of the recent striking and highly successful demonstration of the new vertical method of disc recording it may well be suspected that the engineers of the Bell Telephone Laboratories have succeeded in imparting a new lease on life to that all but moribund sound medium—the disc record. A frequency range sufficient to make sound film green with envy, the virtual elimination of surface noise and an appreciable increase in recording surface are but a few of the many attributes which serve to identify the new system as one of the outstanding accomplishments of the year.—THE EDITOR.

Messrs. Frederick and Stokowski

AN epochal advance in sound recording and reproducing was demonstrated last month to members of the Society of Motion Picture Engineers and the Institute of Radio Engineers in the Engineering Societies auditorium by Halsey A. Frederick, transmission instruments director of Bell Telephone Laboratories. Using disc records cut by the vertical method, a new high-power amplifier and latest types of loud speakers, Mr. Frederick produced an extraordinarily faithful reproduction of organ, orchestral, and vocal music, which his audience could scarcely distinguish from the original in either quality or volume.

Speaking also before the meeting, Leopold Stokowski, Director of the Philadelphia Orchestra, explained the problems connected with recording music from the standpoint of the musician.

Details of Method

The vertical method of recording on wax discs differs from the so-called lateral method which is standard practice in the phonograph and sound picture industries in that the groove instead of wavering back and forth along an otherwise spiral path is a true spiral whose depth varies in a perfect pattern of the sound waves which have been recorded. Such a method was the original conception of Edison but, lacking modern electrical technique, it was superseded by the lateral method. With the availability of microphones, amplifiers and other electrical adjuncts to modern recording the old method now finds itself in the forefront of progress.

Among reasons for its excellence is that the needle is no longer thrown from side to side by the vibrations, with the resulting overtravel and wear on the groove, but rather rides smoothly up and down. A close fit of the reproducing point in the groove —a requisite of the old method—was secured by incorporating a certain amount of abrasive material into the disc which would soon wear the steel needle to an approximate fit. This fit is not required in the new method and hence a permanent sapphire point is used in the reproducer with a resultant saving in weight of the steel needle and its clamping device. A further saving in weight is effected by an electrical reproducer whose moving system consists only of the tiny sapphire point, a coil of flat wire about an eighth of an inch in diameter, and a bit of thin metal to hold the whole in alignment. On account of its lightness, the moving element is able to follow vibrations up to 10,000 per second with entire fidelity.

New Record Composition

On account of the abrasive material embodied in the older records, the reproducing system was designed to eliminate from the output those frequencies above about 3,500 cycles, where "needle scratch" was especially conspicuous. A new method of preparing the original wax for recording, and the use of a finer grained material for the ultimate commercial records make the new record extraordinarily free from this source of noise and thereby brings about a much greater range in volume from the level at which surface noise would intrude on the program to the point at which the moving parts would be overloaded. Further increase in volume is enabled by the use of a vertical groove in which there is no danger, in the louder parts of the program, of the recording stylus overcutting into the adjoining groove.

In copying from the original wax record, it has been the commercial practice to dust the wax with very finely powdered graphite. The particles of graphite were still large enough to contribute to the surface noise so that method has been abandoned in favor of depositing a molecular film of gold thrown down by an electrical discharge in a vacuum. On this gold film a layer of copper is electroplated and the whole is then backed up by a lead alloy. Further operations of pressing the discs are carried out much as in the present process but the ultimate records are pressed in cellulose acetate which has a surface texture extremely fine.

The power amplifier, which is the last of several stages of amplification, consists of two 1,000-watt vacuum tubes connected in push-pull. Mr. Frederick explained that although its full 2,000 watts could be drawn upon if necessary, the reason for the use of such large tubes was in order that they might be very lightly loaded. With loud speakers responding to frequencies as high as 12,000 cycles, the spurious tones produced by a heavily loaded vacuum tube are distressingly perceptible and for this reason none of the tubes in the amplifying system are worked at more than a small part of their rated capacity.

The Views of Mr. Stokowski

The following excerpts from Mr. Stokowski's speech will serve to apprise our readers of the opinions and reactions of a great musician and orchestra conductor regarding the new record and its signification:

"You have heard those records. They speak for themselves, especially from the standpoint of recording. You have seen, I am sure, the great advance in the three main things that are essential: frequency range, volume range, and reducing foreign, extraneous noises.

"That suggestive power which can carry us into the most remote spheres and realms of feeling and thought, and things that are higher than thought and higher than feeling—that is the important part of music. And in order to be able to do that we must have this greater range which we have had demonstrated here tonight—greater range of frequency, of volume, and elimination of foreign noises, needle scratch, static, and all those noises we hear on the radio. We must find methods of eliminating all foreign sounds.

Desirable Volume Range

"When our orchestra plays in Philadelphia, or like we played last night at Carnegie Hall here in New York, we give out a volume range of about 75 db., but when we are recording we do so at 35 db. I think it is important for everybody connected with music, and the public at large, to know definitely and quite clearly—it is no secret; it is a plain thing—that when they listen to a record or when they listen to the radio they are hearing approximately 35 db., sometimes less, sometimes a little more. But when they listen to a symphony orchestra, which is, I think you will agree with me, the most difficult thing to record or transmit, they are hearing about 75.

"We must find a way of increasing that 35 to 75 before we really can give the public what it ought to have in the way of expression in music. That is one dimension, so to speak. Then there is the other dimension, the up and down dimension, the frequency range.

Frequency Range

"When we play as we did last night at Carnegie Hall, through the overtones, or the fundamentals, we are producing frequencies certainly up to 13,000 or more. But we know for sure it is up to 13,000. When you hear a record, or when you hear music over the radio, you are hearing frequencies of about 4,500, often less, sometimes a little more. The average, however, is about that.

"Last Friday we had a concert in Philadelphia and after the concert we made a number of tests in connection with the Bell Laboratories, and these are the exact figures we got from these tests:

"We took the first oboe player and asked him to play certain things. We were in a room a long way from the room in which he was playing. We had previously arranged everything so that what we were hearing was an exact reproduction of what was happening on the stage. The oboe player was sitting in the same seat he always sits in during a concert so that it was an exact reproduction. And we found that he needed up to 13,000 to express his tone color. Then we took the trumpet and we found that up to 8,000 gave a satisfactory effect.

"The piccolo took up to 6,000, and that was an astonishing thing, that the piccolo, which is a very high instrument, should only require up to 6,000, whereas a trumpet, which is a much lower instrument, requires up to 8,000, and the oboe, which is a moderately low instrument, requires up to 13,000. That is something you couldn't determine without exact experiments like these.

"Then we took the violin. It required up to 8,000. The cymbals needed up to at least 13,000, probably more; the tympano, 6,000; the triana, 13,000; the xylophone, 6,000, and the snare drum, 13,000.

"In order to express all this. . . . We must find out what the average room will take in the way of volume range. We really don't know exactly yet. . . . The same thing applies to the theatre in which sound pictures are shown. They vary greatly, and when we record sound—music or speech, no matter what kind of sound it is—we must have those conditions as nearly as possible invariable.

"I see in all this development something new coming. I believe it will be only a few years until the composer will paint directly in tone. He won't write down his impressions on paper. He will express them through frequency, through volume and through duration. In that way he will express his ideas exactly, and not with the imperfections we now have. That is almost possible today.

"What is the ideal for us who are scientists, or engineers, or musicians, or photograpers, or producers of tone films? What can we do in the future which is greater than we are doing now? A great deal, in my opinion.

"We may communicate with someone by telephone. We can communicate ideas. We can come to understandings about ideas. We can talk for a long time on the most intricate, complex subjects and make decisions. But when we combine sight and sound through the tone picture, we can communicate much more—not only ideas, but emotions and suggestions of things which are not completely said, but are conveyed in a more subtle way. We can suggest on levels of consciousness higher than thought and feeling and imagination, and all those strange things that go on in our nervous system which make our inner life so complex and so rich.

"Above all these things for which we have words, we all know well there are other things. We have no name for them, no word for them—but they exist. They are a part of our daily experience. Especially do we feel these things through the finest type of music. Music of the higher type expresses just those things, and it is through radio, and eventually television, that we can project them through space all over the world.

That is the magnificent ideal, something quite supreme, to which we all must work. We must not be satisfied to stand where we are at present—which is at about the half-way point. The development of the radio, the gramaphone, photography and the reproduction of sound has been perfectly miraculous during the last six, eight or ten years, but there is far more to be done. Let us admit that frankly, and work for that immense ideal which is possible.

Lenses: Further Considerations

(*Continued from page* 15)

The above type of lens is called an "achromatic lens," which means literally that it corrects chromatic aberration. Such a lens as we have described, although it is composed of two pieces of glass, is called a "single" lens to distinguish it from combinations of such lenses which are mounted in a tube to form an "anastigmat" lens.

The Anastigmat Lens

An anastigmat lens is a lens which is designed to correct another defect prevalent in simple lenses. This defect is known as astigmatism and makes itself known by causing a picture projected through a "single" lens to show up with a certain amount of distortion around its edges. This distortion comes about because a single achromatic lens must be "stopped down," that is, an opaque diaphragm is placed before or after the lens so that only the light rays which pass through the central portion of the lens are allowed to reach the screen.

If this "stop" is not used the projected image would not be sharp due to the fact that the light rays from the edges of the lens would not come to a focus at the same point on the screen as would the rays passing through the center of the lens. This effect is known as "spherical aberration" and is corrected by allowing only the light rays which pass through the central portion of the lens to reach the screen, the rest of the rays being intercepted by the "stop."

When this stop is used, however, we find that the image thrown on the screen is not "square," or, more accurately speaking, its top and bottom edges and its left and right edges are not parallel.

If the stop is placed in front of the lens the image has a "barrel" shape as shown in Fig. 3-A while with the stop behind the lens the image is "pincushion" shaped as seen in Fig. 3-B. If, however, two lenses are put together with the stop between them the distortion from one lens is corrected by the distortion of the other and the undistorted image appears as shown in Fig. 3-C. These three images are of a window pane, showing in A that the edges are bowed outward, in B, that they are bowed inward and C, that they are straight and true.

Totally Corrected Lenses

Lenses are now being manufactured, however, which give a flat, undistorted image field to the very edge of the picture, so that it is not necessary to use stops. This type of lens is made possible by the manufacturing of new kinds of glass which give a flat field image (both the center and the edges in sharp focus) with all the colors of the spectrum of the same focus.

This final result of the lens maker's skill is called the anastigmat lens. It is relatively expensive due to the high quality of workmanship necessary in its manufacture.

Horns and Their Purpose

By W. L. WOOLF

As the author of the recently completed series of articles entitled "Some Aspects of Loudspeaker Development," which appeared in The Motion Picture Projectionist, Mr. Woolf needs no introduction to our readers. For this issue, the author has chosen a subject with which, as an acoustic engineer of the Amplion Products Corporation, he has every reason to be familiar. Some interesting and informative facts concerning the loudspeaker horn are presented.—THE EDITOR.

ONE of the very oldest acoustic instruments is the horn. Though it is thousands of years old and has been constructed in almost every conceivable form and size, and has been made of practically every available material, it is yet but little understood by the layman and is the subject of much discussion and the object of many questions from projectionists. Some of the questions most frequently asked are: Why does a unit give more sound when the horn is attached than when not attached? Why is the quality of the sound better, particularly on the low notes, when the horn is attached? Why are horns for theatre use made so large? Cannot smaller horns be made that will be equally as good as the large ones? A discussion of the function of the horn and a few of the principles involved in its design will serve to answer these questions.

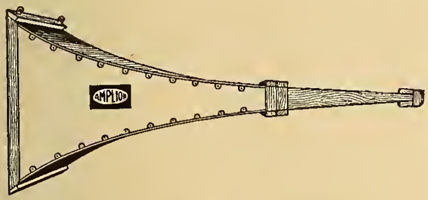


Fig. 1. Six-Foot Trumpet

Function of the Horn

The function of the horn is somewhat similar to the function of a clutch in an automobile. The clutch is the connecting link between the motor and the car. The horn is the connecting link between the reproducer unit and the atmosphere which transmits sound to the ear. Without a horn the reproducer unit is unable to transfer the energy which it receives from the amplifier in any appreciable quantity to the surrounding air. For much the same reason that one uses a spoon rather than a fork for eating soup, and a broad instrument like a fan rather than a slim one like a lead pencil for fanning himself, one uses a horn in connection with a reproducing unit. The horn is able to obtain sufficient grip on the surrounding atmosphere to permit the energy of the diaphragm to be transferred into the air.

The function of a horn may also be compared with that of a step-down transformer which receives a small current of high voltage and discharges a large current at low voltage. The horn receives impulses at high pressure over a wave front of small area at its throat and distributes impulses of low intensity over the wide area of its bell. This change wrought within the horn permits it to transfer more effectively the energy supplied at the diaphragm into the surrounding air. It is for this reason that a unit sounds louder when the horn is attached. No more energy is being put out by the amplifier, but a greater percentage of the energy present has been converted into sound and made audible.

Area of Throat

The opening at the throat of the horn must be small, but not too small. The smaller the opening at the small end of the horn compared with the size of the diaphragm, the greater will the pressure be which the diaphragm develops within the tone chamber of the unit. The loading of the diaphragm permits it to do useful work.

There is another reason for making the area of the small end of the horn as small as possible. The horn is called upon to reproduce sound waves varying in frequency from approximately 50 cycles per second to 10,000 cycles per second. The ideal horn would be one which reproduces all these frequencies with uniform efficiency. Absolute uniformity of efficiency over a wide range of frequencies has never been attained but it has been found that the smaller the opening of the horn, the greater is the uniformity of efficiency over various frequencies. Theoretically, perfect uniformity is reached only when the area of the opening becomes zero.

A third reason for making the throat of the horn small is that by so doing the air confined in the tone chamber above the diaphragm develops a back pressure which dampens the diaphragm and helps to prevent it from vibrating through undesirably great amplitudes at its natural frequency.

While there are reasons for making the small end of the horn very small, there are conflicting reasons why it should be made large. The larger the opening, the shorter may be the horn to fulfill the requirements of size of bell and rate of increase from the small end of the horn to the bell hereinafter to be discussed.

The tone chamber above the diaphragm has a fixed period of vibration of its own. The smaller the throat opening the more pronounced this period becomes. Under some conditions the resonance of the tone chamber becomes as troublesome as the resonance period of the diaphragm which it tends to correct. The throat opening should be left large enough so as not greatly to diminish the volume of air passing through it below the volume displaced by the diaphragm.

The smaller the opening of the horn, the greater will be the throat velocity of the air passing through it. Inability to obtain perfect smoothness of the inside of the throat and perfect alignment inside makes it inadvisable to set up throat velocities of too high an order, otherwise objectionable cross currents are set in motion. Openings in the majority of commercial models are from ⅜ to ¾ of an inch in diameter.

Area of Bell

Let us now consider the large end of the horn. When a horn is in use, there is within it a column of air in rapid vibration. This column may be considered as a plunger which strikes the air outside of the horn and sets it in vibration. The larger the area of the end of this plunger or, in other words, the larger the cross section of the bell of the horn, the more near perfectly will it succeed in transferring into the surrounding air vibrations similar in frequency and intensity to those which motivate it. This is one reason for making the bell of the horn as large as possible and is an answer to the question as to whether or not smaller horns can be made to take the place of large ones.

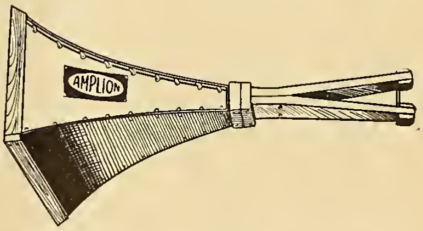


Fig. 2. Twin Tone Arm Trumpet

There is another very important reason why the bell of the horn should be large and in fact must be large if it is to reproduce faithfully notes of low frequency. A law of physics states that to every action there is an equal and opposite reaction. When the plunger composed of the air column within the horn delivers a thrust outward against the air at the mouth of the horn the outside air becomes compressed and reacts against the air inside the horn. If the bell of the horn is small compared with the wave length of the note being reproduced, the area of back pressure is intensified and its reaction travels down the horn as a return impulse, destroying the quality of reproduction. If the bell is sufficiently large, however, the outward thrust and consequent return thrust are distributed over a sufficient area to prevent the back thrust acquiring an intensity noticeably damaging to the results.

This phenomenon does not occur to an objectionable degree as long as the diameter of the bell exceeds one-quarter of the wave length of the note of lowest frequency reproduced. The wave length of any frequency is the velocity of sound divided by that frequency. The velocity of sound being approximately 1,130 feet per second, the wave length of a 60 cycle note, say, is 19 feet. One-quarter of this distance is 4 feet 9 inches. In other words, a horn will require a bell 4 feet 9 inches in diameter in order to reproduce a 60 cycle note without distortion. A 30 cycle note would require a bell diameter of 9 feet 6 inches, an 80 cycle note one of 3 feet 6 inches, and a 100 cycle note a bell of 2 feet 9 inches.

Rate of Expansion

Having determined that the opening of the small end of the horn should be approximately one-half inch in diameter and the opening of the large end from two to ten feet in diameter, depending upon the frequency of the lowest note to be reproduced, how shall the horn be constructed between these two extremities?

This is a most important question in horn design. The oldest horns found in use were conical in shape, the sides being straight. This type of horn has been found to give excellent reproduction on notes of some frequencies but not all frequencies. The ideal horn is one which will give uniformly efficient reproduction for all desired audible frequencies. Mathematics suggest and experience has proved that the type of horn which more nearly than any others meets this requirement is one in which the rate of expansion increases at a uniform percentage.

If we examine the area of such a horn at three points, A, B and C, such that B is equidistant between A and C, the area at A perpendicular to the axis being Sa, that at B Sb and that at C being Sc, we will then find that Sc is larger than Sb by the same percentage by which Sb exceeds Sa. It will also be found that Sb is the square root of the product of Sa and Sc. A thrust at the point A is transmitted to the point C through the point B. A perfect horn will be one in which the entire amount of energy received at A would be transferred to C. No horn is perfect, but it has been found that perfection is more nearly approached when Sb is the mean proportional between Sa and Sc, which is the condition above described.

A horn which expands according to the above rule will be found to double its area at a fixed distance, that is, if Sb is twice Sa and Sc is twice Sb, it will be found that the distance between A and B equals the distance between B and C. If a horn obeying this rule has an area of one square inch at a point P and at a distance D nearer the bell has an area of two square inches, at a distance of 2d from point P the area will be four square inches, at 3p it will be 8 square inches, at 4p, 16 square inches, etc.

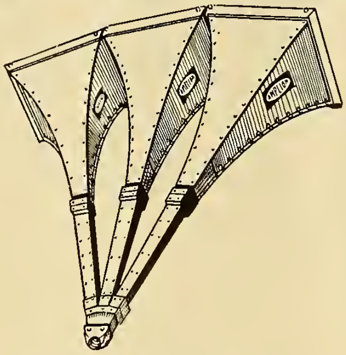


Fig. 3. Triple Trumpet

A Problem in Design

A question which arises in design is, what length shall we make the distance D in which the horn doubles its area? For convenience in handling, storing and transporting the horn, D should be made as short as possible, as the shorter D is the shorter distance will the horn require in which to grow from the area of the initial opening to the area of the bell. As is usual in the design of any equipment, there is a conflicting reason why D should be made long. Horns of conventional or practical dimensions are found to reproduce notes of low frequency with less efficiency than those of higher frequency. As the bottom of the scale is approached, the efficiency ultimately reaches zero and the note no longer becomes audible.

The frequency of the lowest audible note produced by a horn is called its cut-off frequency. It has been found that the greater the distance D, which is defined above as the distance required for a horn to double its area, the lower will the cut-off frequency occur. A horn which doubles its area over two feet will reproduce a 32 cycle note, whereas one which doubles its area in one foot will cut-off at 64 cycles and one which doubles its area over 6 inches will cut-off at 128 cycles. One which doubles its area over three inches will not reproduce notes below 256 cycles.

A horn which doubles its area at fixed intervals of length is popularly known in the trade as an "Exponential" horn regardless of the length of the interval in which the area is doubled. Such a horn is found to reproduce a note of twice the frequency of its cut-off frequency with a much greater efficiency than horns of other shapes and to reproduce all higher notes with practically uniform efficiency, a condition not found in horns of any other shape.

If a horn has an initial diameter of ⅝ of an inch in order to reproduce a 32 cycle note satisfactorily, it will require a bell approximately 106 inches in diameter and an air column between 30 and 31 feet in length. A horn with such an initial opening to reproduce a 64 cycle note will require a bell opening 53 inches in diameter and a length of 13 to 14 feet. A 128 cycle note may be reproduced by a horn with the same initial opening with a bell 27 inches in diameter and a length of between 5½ and 6 feet, whereas a 256 cycle note may be reproduced by a horn 2½ feet in length and 13½ inches across the bell. It will thus be seen that satisfactory reproduction of notes of low frequency requires horns of great length and large bell areas.

Materials and Workmanship

The above principles of design assume materials and workmanship, a condition never realized in actual practice. The high throat velocities attained by good horns demand workmanship of high quality. The inside of the horn should be perfectly smooth. Aluminum sand castings, frequently used in commercial models, are quite unsatisfactory for this purpose. Die castings should be used with smooth interiors or sand blasting, drilling or other means should be resorted to to polish the interior of the horn. Perfect smoothness is particularly indispensable in the first few feet of the horn where the area is restricted and the velocities are high. Any distortion in the early stages of a horn are the equivalent of distortion in the first stage of an amplifier. This distortion is amplified in the following stages until it reaches highly undesirable proportions in the last stage.

The walls of exponential horns should not only be finished to a high polish, but should be of sufficient density and thickness to prevent wall reverberation. Rough materials, soft absorbent materials or materials of non-uniform thickness cannot be expected to give the best results when used for horn manufacture. Inasmuch as the exponential expansion rate should be held to very fine tolerances, particularly in the lower areas, materials should be used which will not shrink, expand or change their shape with changes in temperature and humidity.

(*Continued on page* 40)

An Apertureless Optical System*

By R. C. BURT

An optical system which uses positive and negative cylindrical lenses with their axes at right angles is described. The image of a source is optically elongated and flattened by these cylindrical lenses to the proportions desired, and is then focused on the film. Advantages are: maximum possible brilliancy with a given source temperature; not sensitive to position of the lamp filament; sharpness of image; and intrinsically perfectly uniform brilliance throughout the length of the beam.

THE ordinary optical system for the reproduction of sound from records on film requires some form of limiting mechanical aperture of special shape. It is shown in this paper that not only is the use of such a mechanical aperture not necessary, but the apertureless system herein described has desirable features not obtainable with any other system. In this optical system the image of a finite source of light is optically flattened and elongated until it is in the proper proportion for the light beam on the film. This image is then focused on the film by an achromatic lens.

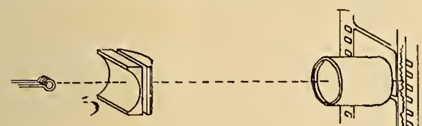


Fig. 1.

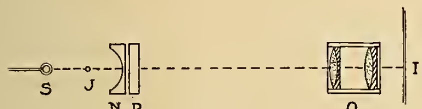


Fig. 2.

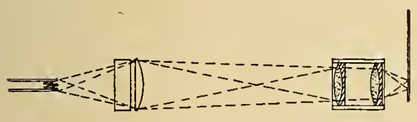


Fig. 3.

Special Lenses Used

As shown in Fig. 1, this result is obtained by using special lenses. In an elementary system two of these lenses have cylindrical surfaces. One surface is negative, its axis being horizontal; the other surface is positive, its axis being vertical. The negative surface reduces the thickness of the filament image, and the positive surface draws out its length.

Fig. 2 is a vertical section in which

S is the source

J is the virtual image of the source

N is the negative surface

P is the positive surface

O is the objective

F is the film

I is the image on the film

It is evident that by properly selecting the power of the negative lens, the virtual image J can be made any desired size so that with a given objective lens it will be reduced to the desired width at I.

Fig. 3 shows the plan section. Each element of the filament is drawn out by the positive lens P until, when observed from the objective, it appears as a long bar of light extending completely across the lens P. Light from each element is then brought to focus at a point on the objective. This appears as an image of the filament along one axis only, being a striated vertical band of light which completely fills the objective. It is obvious that instead of one lens of given power, several lenses of lower power can be substituted.

Selection of Lenses

In applying this optical system almost any available source of light may be used, and by properly selecting N and P any desired size of beam may be formed. The length and width of the light beam required on the film, and the light source which it is desired to use are usually fixed. Given the length of the light beam, the fastest short focus objective commercially available is selected. Usually a microscope objective is satisfactory, as these are inexpensive, highly corrected, and have speeds up to $f/1.0$ or greater. Selection of such a lens automatically places limits on the location of the image J, as these lenses are corrected for a certain working distance and this in turn determines the size of J.

Selection of the power and location of the lens element P comes next because, knowing the length of the selected source, P is chosen so as to fill the objective O completely with light of intrinsic brilliancy, thus obtaining the highest efficiency.

The length of the negative lens N is now determined to give the required length of image I and it is only necessary to compute N for the proper reduction of diameter of S to meet the specified value needed for J.

The mathematical solution of the above conditions is very elementary, requiring only the simple lens equation. Solution by maxima and minima for the shortest possible optical system with a given set of lens O and N is difficult, a graphical solution being much easier.

The advantages of this system in comparison with others are easily understood and may be enumerated as follows:

A glance at Fig. 3 shows one that the objective O is completely filled at all points by light of intrinsic brilliancy from all points on the image J. Hence the system is 100 per cent efficient, giving the maximum brilliance possible in the image I for any system using a source of light S and passing it through any lens. The only way a more brilliant image can be obtained is by using a faster lens at O or by increasing the temperature of the source S.

It is not sensitive to position of the filament. Referring to Fig. 2, S may move up or down, forward or backward, with only a small change in the position of J, due to the effect of the lens N. As a result of this feature a standard source such as an automobile headlight bulb is perfectly satisfactory. Once designed, all standard headlight bulbs are perfectly interchangeable without any refocusing whatever.

The effect of azimuth errors in the filament do not appear as an inclined light image, but only as a very slightly broadened image. When using an automobile headlight bulb, the filament coil may be rotated 30 degrees from the horizontal and the light image width is increased only 60 per cent.

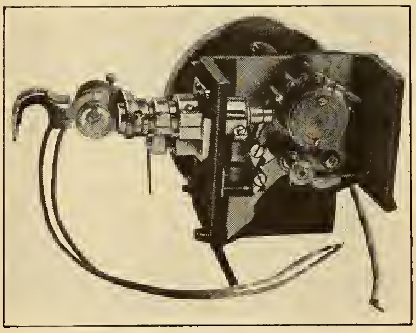


Fig. 4. The Optical System

Advantages Continued

The image is very sharp, clean, and true, being formed by an optical surface instead of a mechanical slit as is the usual custom.

The most unique and important of all advantages is the fact that the light beam is perfectly uniform in intensity throughout its length. As will be evident from Fig. 3, this result is achieved because the horizontal image of the filament, which is composed of the coil elements, is focused on the objective O and consequently cannot possibly be in focus on the film. Furthermore, each coil element is drawn out by the positive lens P

---

* Courtesy of the S.M.P.E. Journal

and is focused by the objective lens *O* upon the film, making a complete light beam in itself. It is the sum total of all such elements added together on the same line that makes the fine, clear, brilliant image obtained.

This uniformity of light across the image makes a finer reproduction especially in the case of variable width recording, where variations in brilliance along the slit cause volume or harmonic distortions for which it is impossible to compensate.

Discussion

Mr. Palmer: I should like to know if Mr. Burt has any figures on the efficiency of his system. Can more light be gotten on film from the same light source than from the slit system?

Mr. Burt: We can get considerably more light than with a slit system. No figure of the efficiency of the slit system is available, and we cannot calculate the theoretical efficiency of a slit; but we have measured slit systems, and have found that the slitless system is about four times as efficient.

The efficiency of this system is determined by the speed of the lens, *O*, and the intensity of the source, *S*. More light cannot be obtained from any optical system which uses a projection lens than from this system because the lens *O* is completely filled with light. Consequently, the amount of light that can strike the film is determined by the angle of the lens and the brilliancy of the source. If you trace out the light rays from all points on lens *O*, the filament *S* appears of intrinsic brilliancy throughout the field.

Mr. Palmer: How about using this for recording and getting an image of a glow lamp?

Mr. Burt: In a Movietone recording lamp, about 90 per cent of the illumination comes from a little tube around that element approximately 0.125 to 0.25 inch in diameter and of a length from 0.25 to 0.5 inch. It becomes a problem to take illumination of that size and put it on the film in the form of a slit. We find that with an optical system 13 inches long, we can do it with one lens with a negative curvature on one side and a positive curvature on the other side, and reduce the image to a virtual image 0.006 inch in diameter and stretch it out to a length 6.125 inches long; and then focus this on the film 0.187 inch in length by 0.000085 inch in thickness.

Lamp Development Work

Mr. Shea: With respect to the lamp problem it should be said that a great deal of development work has been done by lamp manufacturers during the last few years, and they have designed improved lamps for sound picture recording and reproduction. The efficiency of the lamp (its power consumption with respect to the light emitted) and the maintenance of high color temperatures over long periods of time, and the uniformity of the illumination across the filament are important factors. I want to make a plea, therefore, even if one has a good optical system, for using an equally good lamp.

Mr. Burt: When we were first working out this optical system the regular exciting lamps were difficult to obtain except by those licensed. We therefore had to use the best source at hand and to design our system around it. The automobile headlight filament is V-shaped and only rarely does one get a lamp out of line by so much as 10 degrees. We feel that the optics of this system are fundamentally sound for any light source. Furthermore, it is possible to make use of lamps with very small filaments because we have an optical system here which can make efficient use of any filament we start out with. Fig. 5 shows a negative made by projecting the image through a microscope objective, enlarging it to 1000 diameters.

Fig. 5. *Upper: Beam Magnified* 1,000 *Diam. Lower:* 70 *Diam.*

Frequency Response Measurements

Mr. Larson: Have measurements of frequency response been made? What have the results been with respect to the high frequency range?

Mr. Burt: Theoretically, there is a slight limitation to the angle which can be used in an objective lens. If the angle gets too high, or if you use lenses which are super-fast, such as lenses of *f*/1.5, we get such large angles that the scattering is increased. This is true of all optical systems. So far as this optical system is concerned we can make the image on the film any degree of fineness desired. They have been made 0.0001 inch in width.

In an actual test, one of the studios made a film experimentally which had a 15,000-cycle note recorded on it. The level was a little low, but it was put in a standard sound head using a slitless optical system, and we ran the film through. We took the current out of the head amplifier and passed it into a Bedell-Reich stabilized oscilloscope, and made the image stand perfectly still. We then examined the form of the 15,000-cycle sound wave and found it to be as good as that of the usual 60-cycle line voltage.

Mr. Foster: What is the angle of the microscope between the axis of the lens and the end of the image?

Mr. Burt: That depends upon the selection of the lens, the diameter of the lens, and its focal length.

Lens Corrections

Mr. Foster: Is there any difficulty due to curvature of field?

Mr. Burt: No. Microscope lenses are corrected for flat field.

Mr. Foster: Is there any falling off in the intensity due to the diminishing of the aperture of the lens as you approach the end of the lens?

Mr. Burt: That is the thing that determines in these lenses what their correct field is. We are using a 16-mm. lens in order to cover a 2-mm. length. We do this in order to use the highly corrected center part of the field. We can make that angle as small as we want. Ordinarily for commercial work we select short lenses. In working with Fox they wanted a 0.25 inch length, so we had to make a longer focus lens in order to get a corrected field.

Syncrofilm Sound Head for Small Theatres

A sound head, adaptable for either the Simplex or the Power's projector, and designed especially for use in small theatres, is available in the Syncrofilm Model J sound head, a product of the Weber Machine Corporation, it is announced by officials of that company.

The sound head is simple in design, and compact and sturdy of construction. The sound head drive is direct, and secured by means of two round woven endless belts which couple the motor to an accurately balanced combination pulley and flywheel. The projector drive is taken from the sound head drive shaft, a high-grade silent chain being used for the purpose. The drive is smooth and quiet and assures correct reproduction of music or voice without tremor, waver or other form of distortion, the company declares.

Sound Picture Installation for Riverside Church

Sound motion pictures soon will be shown in the $4,000,000 Riverside Church, Riverside Drive and 122nd street, New York City, of which Dr. Harry Emerson Fosdick is minister and which is considered to be one of the most imposing structures in the world. Negotiations have been completed between George J. Heidt, business manager of Riverside Church, and RCA Photophone, Inc., for the installation of a complete special size sound reproducing unit in the assembly hall level of the edifice, which has a seating capacity of about 500.

Reducing the Fire Hazard

By JEROME J. GREILSHEIMER

Nitro-cellulose film, as we all know, is highly combustible and its handling requires constant vigilance. To the enduring credit of the projectionist fraternity it may be said that it has to a man always recognized its responsibility in this respect. The marked absence of serious fire bears irrefutable testimony to the fact. In the following article the author describes a series of tests conducted by the Underwriters' Laboratories to determine the properties of a new type of film cabinet and its adaptability as an aid in the prevention of film fire. Mr. Greilsheimer is president of the Film-Safe Corporation.—THE EDITOR.

THE safe storage of motion picture film even in small quantities and for short periods of time has always presented a serious problem, but its terrifying possibilities can be fully appreciated only by the projectionist who has experienced a film fire of even limited size.

Nitro-cellulose film, such as is now in universal use throughout the moving picture world, is usually stored either in sheet metal lockers with vents and sprinklers, or in the case of large quantities, in concrete vaults which are equipped with sprinkler systems or vented. Neither method has proved efficient in preventing film fires, because of the great mass of film concentrated at one location with no means of isolating fires to small quantities of film. Experience has shown that the gas given off from large quantities of film becomes ignited and explodes with terrific force.

Problem of Storage

It is obviously difficult or impossible to store and handle material as intrinsically hazardous as motion picture film without risk and the realization of this fact has led to the design of film vaults which furnish considerable protection. It is manifestly difficult, however, to construct vaults at all locations where film is handled. In many places, such as motion picture theatres, the amount of film being used or in storage is not sufficient to justify the cost of a vault.

In case where vault storage is provided, the loss of time incidental to obtaining film from and returning it to the vault encourages the accumulation of considerable quantities of film outside the vault with little or no protection. The solution must, therefore, be found in some form of cabinet which will permit the film to be stored in a position where it may be easily handled and which does not require a large initial expenditure, additional cabinets being obtained as needed.

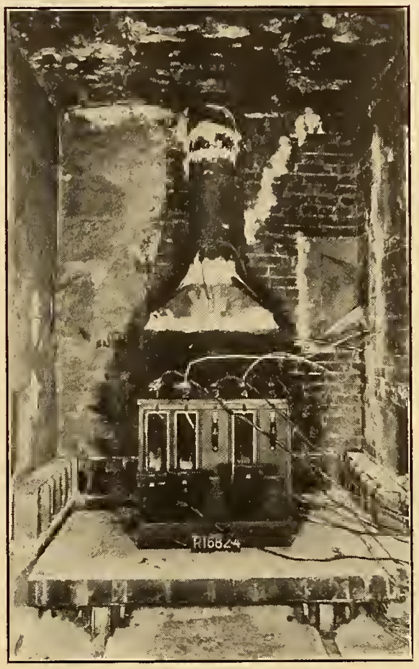


Fig. 1. Sample Before Test

The requirements of such a cabinet may be roughly enumerated as follows:

First—That film not exceeding 10 pounds be stored in individual insulated compartments, sealed tightly with automatically closing and latching doors, each compartment individually ventilated through an automatic pressure relief valve to a duct which leads to the outside air.

Second—That burning reels in the compartments described will not communicate sufficient heat through the partition dividing it from its adjacent compartment to ignite nitro-cellulose film in that compartment, although reels of film may be burning on either side of it.

Third — That only a minimum amount of gas escape around the joint of the self-closing doors and the quantity that does escape must offer no hazard to those near it, either from suffocation or from explosion.

Fourth—That external fire similar in degree of temperature to that shown by a standard fire curve will not cause explosion or in other ways add to the force of such a fire.

Fifth—That any quantity of film may be stored in the device, not to exceed 10 pounds to the compartment.

Sixth—That when the device is submitted to the Standard Fire, as established by the National Board of Fire Underwriters, the film will not be ignited at one time and that there be an interval of one minute or more between the ignition of the individual reels of film. In this manner it is impossible for quantities of film to become ignited at once through external fire.

Construction Details

A film cabinet designed to meet these rigid requirements presents no inconsiderable task, but that the obstacles have been overcome is amply demonstrated by the fact that such a cabinet has been submitted to exhaustive tests, conducted by the Underwriters' Laboratories with highly gratifying results. A brief description of the nature of these tests as outlined in the Laboratories' Report will prove interesting, not only as an indication of the excellence of the equipment under test, but also as an indication of the painstaking thoroughness of the Laboratories' methods.

Compartments Vented

The film cabinet is of unit construction. It is made in two sizes: one style for the storage of 1,000-foot or approximately five-pound reels in each compartment, and the other for the storage of 2,000-foot or approximately ten-pound reels in each compartment.

Fundamentally each cabinet consists of an insulated metal container divided into insulated compartments, each compartment designed to hold a single roll of film and individually vented to a common flue which opens into a hood. This hood is in turn connected with a smoke vent leading to the outer air.

The films are suspended in a film carriage, which is automatically moved forward when the door of the compartment is opened. The door of each compartment closes and latches automatically.

Sectional in Design

The cabinets are designed to rest one on the other and provide storage for considerable quantities of film, provision being made for fastening the cabinets together somewhat like sectional bookcases. The manufacturer ordinarily provides the metal base designed to raise the cabinets off the floor and the hood for the top. The vent pipe is usually provided by the purchaser.

Specifically, the cabinets are intended for the storage of nitro-cellulose moving picture film in motion picture booths and at other locations where it is necessary to have a limited amount of film on hand and the use of a vault is impossible or inconvenient.

The investigation described in the following paragraphs was conducted by the Underwriters' Laboratories. It was planned to furnish data on which to base an opinion regarding the extent to which the various hazards connected with the use of nitro-cellulose film have been guarded against, with a view to making recommendations regarding its use.

Tests were conducted to determine the possibility of fire communicating from one compartment to adjacent compartments, the escape of smoke from compartments containing burning film into the surrounding room, the adequacy of the provision made for taking care of the products of combustion and the danger of explosion when the film in several compartments ignites at approximately the same time.

Fire Test No. 1

The first test was conducted to determine the communication of fire between compartments. The cabinet was set in the Laboratories' furnace No. 3, which is usually employed for testing safes and a 10-inch, 16-gauge sheet steel pipe was connected to the hood by means of a breeching, the pipe passing through the back wall of the furnace and entering a test room ordinarily used for testing roofing. This latter room is provided with a chimney stack capable of taking care of smoke and fumes. This arrangement permitted observations to be made of the quantity of smoke given out by the films when burning, and to a certain extent furnished information regarding the action of the valves by means of which each compartment is vented into the hood.

A 2,000-foot reel of nitro-cellulose film was placed in each of the compartments and the doors of compartments Nos. 1, 3 and 5 were closed, and the films in compartments Nos. 2 and 4 were ignited. When the reels of film were burning the doors were closed and observations were made as to the escape of fumes from the cabinet.

For the determination of temperature rise, a thermo-couple was placed in each compartment. Thermo-couples were also placed in the flue, at the joint of the compartments containing burning film, at the breeching which collected the fumes generated during the test, and also at the side of the cabinet.

Result of the Test

When the films were burning well, the doors of compartments Nos. 2 and 4 were closed and a small amount of fumes was noted 20 seconds later and increased to 45 seconds at which time fumes appeared to be issuing from all door joints. At 1 minute and 15 seconds the fumes decreased and at two minutes no fumes appeared to be issuing.

Smoke and fumes from the stack continued to issue until about 25 minutes from the start of the test. The smoke escaping from the cabinet was not sufficient in quantity to cause any discomfort in the test room.

The cabinet was allowed to stand without opening for several hours. When the sample was examined the joints at the doors of the compartments containing the burned film were covered with a substance having the appearance of asphalt. The ignited films were burned practically to ash. The reels of film in compartments 1, 3 and 5 appeared to be practically intact and as good as before the test, with only slight indication of decomposition on the first turn of film and on the edges. No indication of burning film was noted in compartments 1, 3 and 5 and the temperature rise did not exceed 124 degrees F., reaching a maximum temperature of 184 degrees F.

Fire Test No. 2

This test was conducted to determine the inflammability of the smoke. The same sample was used in this test as that described in Fire Test No. 1, and similar methods were used in this test as in the previous test referred to.

A 2,000-foot reel of nitro-cellulose film was placed in each compartment and the doors in the compartments Nos. 2 and 4 were closed. The films in compartments Nos. 1, 3 and 5 were then ignited.

Result of Test

When the films were burning the doors of compartments Nos. 1, 3 and 5 were closed, but the film in compartment No. 1 did not continue to burn after the door was closed.

The fumes coming out of the door joint of the compartments containing the burning film were ignited with a match and burned for a period of 1 minute and 45 seconds and then extinguished themselves. No flames were over 12 inches in length.

The maximum temperature indicated in compartments adjacent to the compartments containing the ignited film was 218 degrees F.

In order to determine whether the film would burn through the door joint, the end of the roll of film on the interior was clamped into the door and ignited. This was attempted several times but in no case did the burning of the film continue into the interior of the compartment.

Fire Test No. 3

The test may best be described as the explosion test. The blocks carrying the cabinets were set in furnace No. 3, usually employed for testing safes, and four cabinets of five compartments each were mounted on the blocks. The hood was placed as recommended by the manufacturer and fastened to the breeching; the pipe passing through the back wall of the furnace entering a test room of the laboratories ordinarily used for testing roofing, which is provided with a chimney and stack capable of taking care of smoke and fumes.

This arrangement permitted observations to be made of the fumes given off by the films while burning; the time when the films were ignited, and to a certain extent furnished information regarding the action of the valves by means of which each compartment is vented into the hood.

The twenty compartments were each provided with a 2,000-foot reel nitro-cellulose film, making a total of 40,000 feet (approximately 180 pounds) and thermo-couples were inserted into the compartments for the purpose of obtaining the ignition point of the film. The doors of all the compartments were closed and the furnace fire ignited. The temperatures of the furnace fire were in accordance with the Standard Time Temperature Curve.

Result of Test

The paint on the exterior of the sample blistered shortly after the furnace fire was ignited. The doors appeared to be bulging and the joints opening at two minutes. At the end of the first five-minute period the exposed metal of the sample was generally bulged and the paint flaking on all surfaces. No great distortion was noted on the outside of the cabinets throughout the test.

The furnace fire was fairly bright from the start and appeared well distributed and the temperatures were fairly close to the Standard Curve. At various periods during the test a burst of flames other than those generated by the fuel of the furnace appeared to be in the test chamber and were apparently from the film igniting in the chamber. At various periods the smell of burning films was noticeable in the test room.

Observations at Vent

Observations at the vent outlet are as follows:

Paint smoke coming from the outlet in 1 minute, dying down at 5 minutes and increasing slightly at 6 minutes. Ignition of film in 14½ minutes. Second ignition at 15½ minutes. Other ignitions took place at 18, 20, 23, 25, 27½, 28, 30, 30½, 31 and 31½ minutes. Smoke continued after each ignition for periods varying from 45 seconds to 1 minute.

Frequently small particles of burning film were thrown out of the vents. It was evident that more than one film ignited in some cases, especially in films recorded as igniting at 31½ minutes as the smoke at this time continued for about 3 minutes.

The results of the test indicate that the films were ignited at various intervals from the 14-minute to the 40-minute period and at temperatures ranging from 405° F. to 630° F.

Upon opening the compartment after the test, only light ashes were found in all compartments, except No. 9, which appeared to have slow-burning film within the reel. All film was tested before the test to make sure it was nitro-cellulose film, but apparently that in compartment No. 9 was not entirely nitro-cellulose.

The furnace was extinguished when the temperature indicated that all the films were burned.

Fire Test No. 4

These tests were designed to obtain evidence of the amount of smoke given off by the cabinets under various conditions. In general the test procedure was the same as that used in Test No. 1 and consisted of lighting the reels of nitro-cellulose film, closing the doors of the compartments and observing the amount of smoke given off, and making photographs intended to give visual evidence of the amount of this smoke.

Three distinct tests were made, but owing to lack of space but one of them will be described as affording a fair conception of the others.

The film was placed in compartment No. 2 and ignited. The smoke that first issued from the compartment was of a brown color. This color soon changed to white. Although there was considerable smoke it was not sufficient in quantity to inconvenience the photographer, who was within 8 feet of the cabinet and would not in the observer's opinion (an Underwriters' official) constitute a dangerous quantity in a room of average size.

After the test had been running for about one minute, the smoke being given off was ignited by a match and burned around the door joints. There was not sufficient smoke surrounding the cabinet to make this ignition of smoke at the door joints appear in the least hazardous.

Underwriters' Conclusions

The following are a few brief excerpts from the conclusions deduced as a result of the tests. They are incorporated in and form a part of the Underwriters' Report:

"The device provides a receptacle which permits film being conveniently handled, and a means for increasing storage as needed without large initial investment. It is sufficiently strong to withstand stress to which it will ordinarily be subjected and will not deteriorate rapidly.

"Film stored in these cabinets will ignite and burn when subjected to such fire conditions as may be anticipated in an ordinary fire, but the ignition will not be immediate or necessarily simultaneous. Film burning in one or more compartments of the cabinets will not ignite film stored in adjacent compartments.

"The handling of the cabinets incidental to shipping, and the installation for test, did not damage them and no tearing of metal or rupture of joints occurred during the tests. The dissection of the cabinets after test did not disclose any corrosion.

Wide Ignition Margin

"When four cabinets were installed in the safe testing furnace, and surrounded on five sides with flames, the temperature being increased in accordance with the Standard Curve, the films began to ignite in about 14 minutes, while some of them did not ignite until 31½ minutes. It is obvious that the films on the outside of the cabinets are more exposed than the films in the middle, which would ordinarily cause the films in compartments 1 and 5 to ignite sooner than the films in 2, 3 and 4.

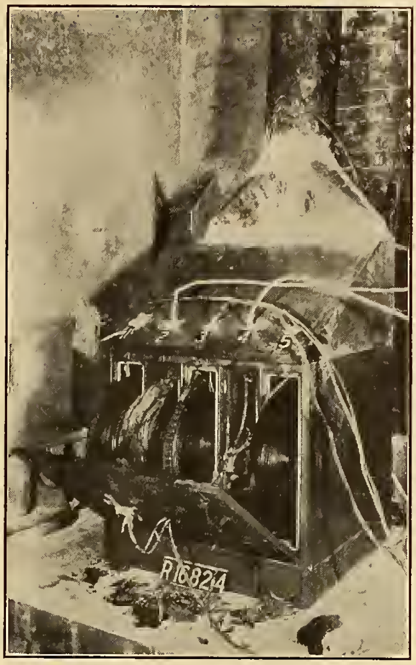


Fig. 2. Sample After Test

"It is doubtful if, under actual fire conditions, it would be possible to obtain an exposure which would ignite all the films at one time, but even in such cases the behavior of the sample in Test No. 3 would indicate that the smoke from the burning film will be taken care of.

No Fire Communication

"In none of the many tests in which film in one compartment was ignited, while adjacent compartments contained unburned film, did the fire communicate from one compartment to another.

"The result of several tests shows that the ignition of the end of the film, left projecting from a compartment, with the door closed, will not cause the burning of the film in the compartment. In other words, the engagement of the door is so close that the film will not carry fire into the closed compartment.

"The burning of film stored in these cabinets does not endanger life by liberating into the surrounding room a sufficient quantity of smoke to render a person standing in the vicinity unconscious or to cause a smoke explosion when ignited.

"The above conclusion assumes tightly closed compartment doors in all cases.

Concerning Smoke Hazard

"It is probable that there is less hazard connected with freely burning film than with partially smothered, unless adequate provision is made to prevent accumulation of smoke. When film burns freely the smoke is consumed as given off, but when there is partial smothering of the flame very liberal amounts of the evolved smoke and combustible vapors are delivered in ignition and may later ignite in quantity; and if in any way confined the ignition may take the form of a destructive explosion.

"It is believed that the device forming the subject of this report is worthy of recognition, as it segregates the film in small quantities and provides separate ventilation for each unit."

Modern Effect Lighting

(*Continued from page* 19)

then made into the form of lantern slides. Depending upon the manner of their use, either one or two slides are employed.

Scenic slides are of three general types:

1. Single slides, which are used for creating stage scenes by the projection method and for making a border for song slides.
2. Positive and negative slides which are capable of a large variety of applications in obtaining beautiful color effects. (See Figures 3 and 4.)
3. Complementary slides, wherein a master slide is used to provide the basis of the scene and a second slide completes the scene by providing local action.

Single slide subjects can be used alone or in combination with a moving effect as previously described. When used alone the common method is to project them onto a large white screen to form a setting for song slides.

Double scenic slides can be used in a number of ways. Thus they can be employed interpretatively for overtures, preludes, feature pictures, curtain designs, organ selections, etc.

A particularly pleasing phase of effect work is the projection of curtain designs. These designs, which may be either in the nature of outdoor scenes or overall patterns, are imaged on the draw curtains and projected, successively, in as many colors as may be desired.

Color is imparted to the finished effect scene by the simple expedient of placing suitable gelatine screens before the projection lens. Where solid coloring of the scene is desired, a single color is placed in the frame. For coloring local areas of the scene, colored gelatines corresponding to the coloring of the local areas are mounted in the frame to form the composite screen.

Outline of Sound Recording

By GEORGE DOBSON †

The author continues his series of informative articles on Sound Recording with a consideration of drive speed, power sources, charging apparatus and a description of the manner in which the equipment is operated in the production of a talking motion picture. An intelligent appreciation of the principles of sound recording, such as may be gained through a careful study of the facts as presented by Mr. Dobson, cannot but make its influence felt in the more effective and convincing presentation of sound in the theatre.—THE EDITOR.

Part V

ONE of the early problems which had to be solved before satisfactory talking motion pictures could be made was the obtaining of proper synchronization between the intermittent motion of the picture film and the continuous motion of disc or film required for the production of sound. At least, this is the way that it appeared to the early designers, but later it was found that the real problem lay in trying to keep the speed of the sound drive without appreciable variation.

Serious variations of low frequency (a few per second) are easily recognized by the flutter which they produce in the sound. Very slow changes cause a drift in the pitch of music although they are not so easily recognized in speech. More rapid variations cause fuzziness and loss of quality in both speech and music. Such variations in speed may be caused either by the original source of power or by irregularities in the connecting mechanism whether this be in the reproducing equipment or in the recording equipment.

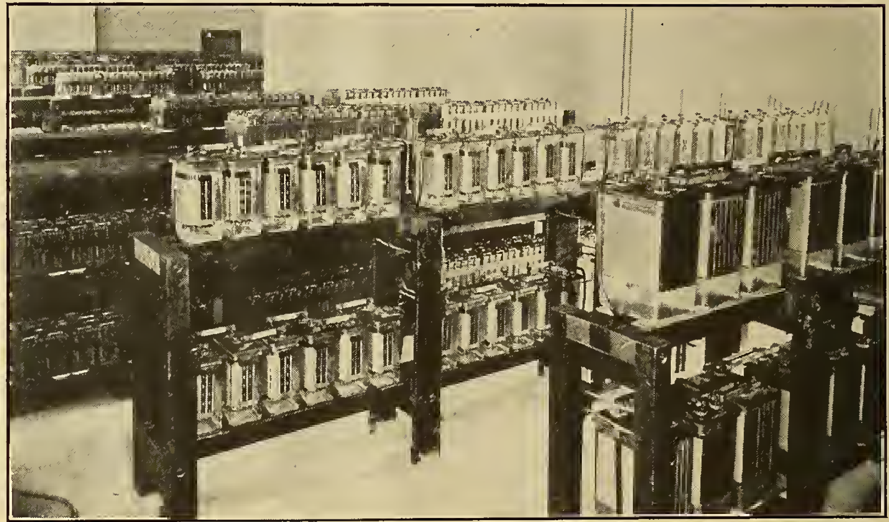


Fig. 16. *The Battery Room*

Steady Speed Essential

Absolutely exact speed is not so important as lack of speed variations since a sense of absolute pitch is rather rare and the ear readily tolerates slight departures (of the order of 1% or 2%) from the nominal pitch. Larger changes are, of course, noticeable since the difference in the normal pitch of a bass voice and that of a baritone voice is at the most a few semitones. (When two notes differ by a semitone, the higher one has a frequency somewhat less than 6% greater than the lower on the basis of the equally tempered scale.)

The problem of constancy of speed in the Western Electric System of sound recording was solved by the use of a master drive or distributor. This distributor acts as a speed regulator for the motor drives of both the recording machines and the cameras. It is in turn driven by a motor whose speed is very closely regulated by means of an elaborate vacuum tube circuit similar to the speed control circuit used in the first Western Electric theatre systems.

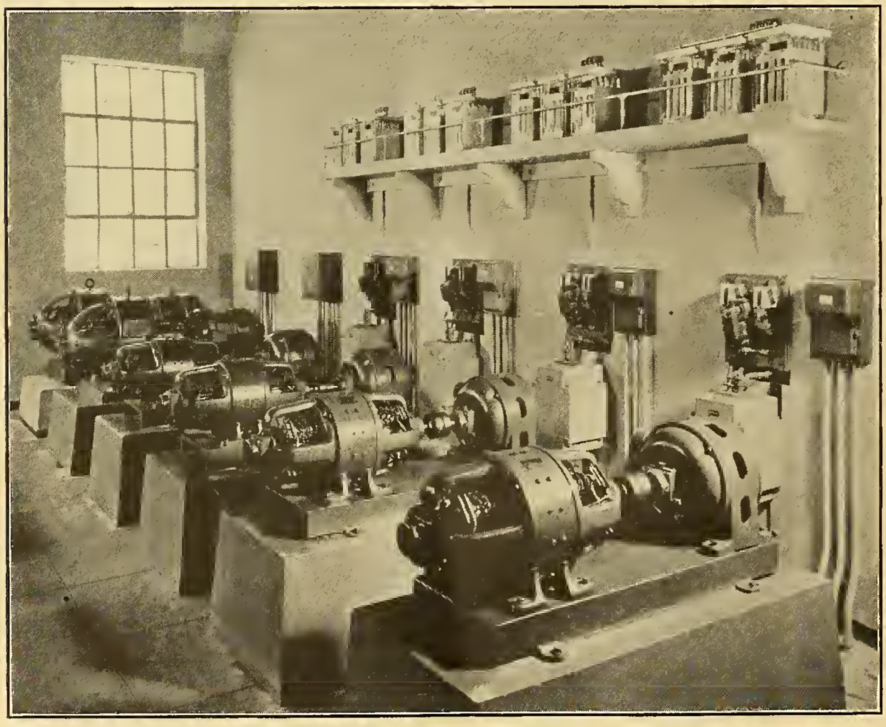


Fig. 17. *Charging Equipment*

Leeway in Film Recording

Experience (together with improved designs) has shown that where the sound is recorded only on film a simpler drive can in many cases be used. For instance, in newsreel work, where the shots are as a rule short and only a single drive is required because both sound and picture are on the same negative, a direct current motor driven from storage batteries of adequate size may be used. Also in some cases where the alternating current supply is very stable in frequency and is not subject to surges due to the switching on and off of heavy motors (or similar causes) synchronous motor drives have proven quite satisfactory. However, where disc records are made or where the uttermost precautions to insure good quality can be taken the more elaborate drive discussed above is preferred.

---

† Commercial Engineering Dept., Electrical Research Products, Inc.

The advantage of this drive in disc recording is that the picture film and the disc are kept in synchronism during the starting period, the recording period and the stopping period. The wax is quite heavy and requires several seconds to come up to speed. If excessive power were to be applied to increase this speed, it would probably damage the delicate machinery required to prevent flutter.

The exact synchronization of the sound and picture is rather difficult unless they are kept in exact step from the very start. Advantage is taken of this starting period to provide a starting spiral somewhat spread out compared with the rest of the record. This makes it possible to distinguish clearly the correct starting point of the spiral when the general location is marked by an arrow scratched in the wax.

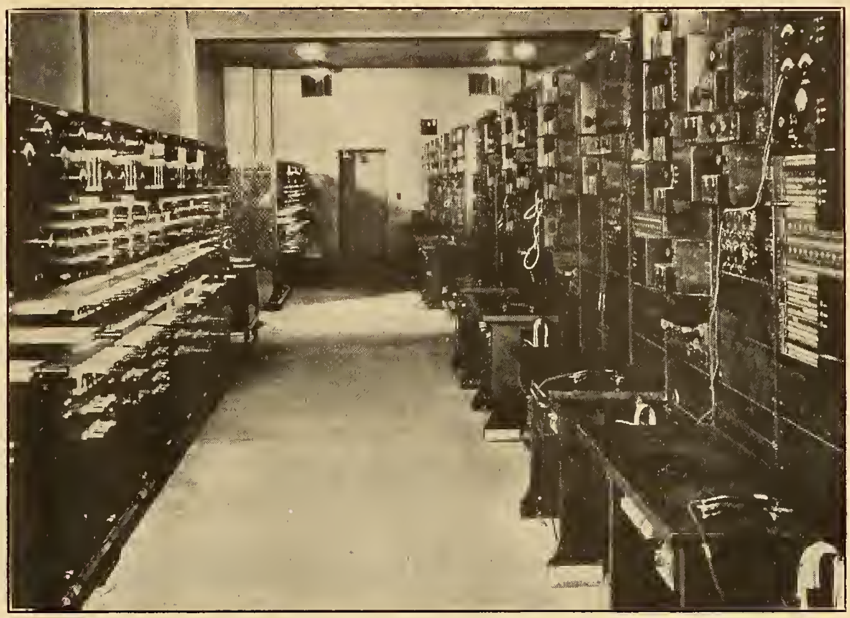


Fig. 18. The Amplifier Room

Power Sources

The power necessary to operate the motors for the camera and recording machines is usually obtained from the power plant which supplies the studio with its other alternating current. The direct current used by the distributor motor must be obtained from some direct current source. This is usually a motor generator set, a rectifier or even storage batteries.

In addition to that used in the drives, the consumption of electricity in the recording equipment is quite large. Energy must be supplied to the main microphone and other auxiliary amplifiers in the form of low voltage current for the filaments, and relatively high voltage current for the plate. Where "C" bias on the amplifiers is not obtained by means of voltage drop in a resistance, small "C" batteries must be inserted in the amplifier itself. In addition, current is required for lighting the lamp on the film recorder and for the field of the light valve. On the disc recorder a small current is needed for magnetizing the field of the recorder.

Charging Equipment

All these requirements involve a number of batteries and means for charging them. In some cases rectifiers can be used to replace batteries, but great care must be taken in making such substitutions owing to the possibility of introducing noise whose source would be difficult to trace. The probability of such noise troubles is sufficiently serious that all of the original recording equipments used batteries to supply their direct current. The use of rectified current is gradually increasing and as the batteries become worn out and need replacing in the older studios, and as new equipments are placed in new studios, many of the batteries will be displaced by various types of rectifiers.

In large studios it is the practice to have the batteries for four or more channels located in a single battery room (Fig. 16) and the corresponding power equipment, charging equipment, distributors, etc., in a separate room (Fig. 17). The control and distribution board may be located in the amplifier room (Fig. 18) or in the power room.

In some studios the complete equipment for each channel is permanently wired together and connected to the outlet boxes on one stage only. It is this arrangement which is shown on the diagrams in this series of articles. In other studios the equipment is so connected that any channel may be used with any stage within the group and any piece of equipment ordinarily connected in the channel may be "patched out" and a similar piece of equipment from another channel substituted.

For the sound circuits these changes are usually made at the test and patching jacks on the amplifier racks (Fig. 18). A separate patching board for connecting together the distributor, motors, and sources of electric power is however required. Six terminal plugs and jacks are required to avoid misconnections of the motors. Such a patch board is shown in Fig. 19.

Operating the Equipment

Having now discussed briefly the various pieces of apparatus used in a sound recording studio it may be of interest to consider the actual operation of this equipment when it is being used to record the sound for a talking motion picture. The sound crew usually consists of (1) a sound man on the stage who is responsible, under the monitor, for proper placement of the microphone; (2) the monitor, who controls the sound during the recording in the monitor booth; (3) one man at least for each group of amplifiers and (4) a recorder at each of the recording machines, particularly where disc is used; where only film recording is being used, one man can take care of two machines.

In order that we may closely follow the sequence of operations let us imagine that we can move rapidly from point to point in a studio during the "take." Of course, if we were actually on a stage during a "take" we must remain very quiet, for a slight motion, not to mention a whisper, may introduce a noise which will have to be cut out. As it is extremely difficult to do this—particularly if the noise happens to interfere with some speech—such an occurrence usually necessitates a retake, with its lost time and disastrous effect upon the nerves of the artists and directors and others.

Making a "Closeup"

We will start on the stage where all is ready to make a "closeup." To

(*Continued on page* 36)

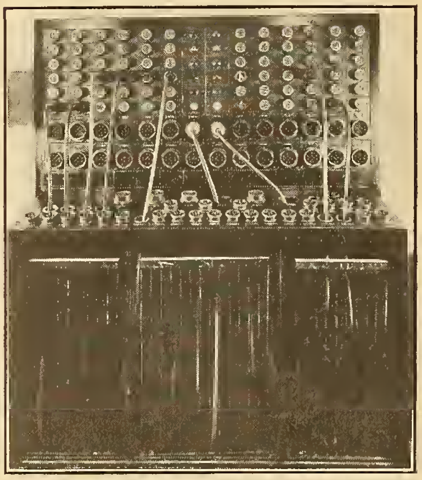


Fig. 19. Patch Board

New Equipment and Appliances

Weston Illuminometer

AN instrument has recently been developed which reads illumination intensities with the same ease and facility as reading ammeters and voltmeters. This instrument was developed by the Weston Electrical Intrument Corp., of Newark, N. J., and is known as their Model 603 Illuminometer.

It consists of an indicating instrument and a light target assembled in a portable case. The light target is on the end of a flexible cord so that it may be placed in any position. This light target or searching unit has two Photronic Cell units which convert light energy directly into electrical energy without the use of batteries or other auxiliary voltage. They maintain constant output over long periods of time and there is no dark current. The output from the Photronic Cell units is considerable, allowing the use of a rugged portable instrument calibrated directly in foot-candles.

The Weston Illuminometer

There are three ranges on the instrument, namely 10, 50 and 250 foot-candles. A range changing switch is provided for the selection of the desired scale. Other combinations of ranges are being added to the line, and will be available shortly. The light target may be placed at a distance from the observer so that shadows and lights reflecting from light clothing will not cause errors in readings. Light may be read from all angles and the light target may be placed in relatively inaccessible places. The absorption of light by painted walls, screens, draperies, etc., can be measured directly by turning the light target so that it faces the surface.

Illuminating engineers who have reviewed this instrument feel that it is what the illumination profession has been needing for the last 20 years. Readings may be taken quickly and accurately and the time required to make a lighting survey is about one-tenth of that previously required.

New Ventilating Fan

A novel ventilating fan specially designed for use in the projection room has recently been announced by the Vallen Electrical Company of Akron, Ohio. This latest product of the firm universally known for its curtain control equipment embraces a number of unusual and attractive features. Called the Vallen adjustable volume ventilating fan, the unit is so constructed that the fan blades are interchangeable, thus making the fan instantly adaptable to any special requirement.

It is the claim of the manufacturer that the new Vallen adjustable fan is incomparable in design, capacity, efficiency and performance. It carries the usual company guarantee.

Automatic Current Controller

A NEW automatic current controller for arc projection machines is announced by Cutler-Hammer, Inc., of Milwaukee, Wis. The new controller, it is stated, is designed to replace the usual knife switches used to control the current to the carbons of the projection machine, and offers many features for greater safety, less maintenance and better efficiency.

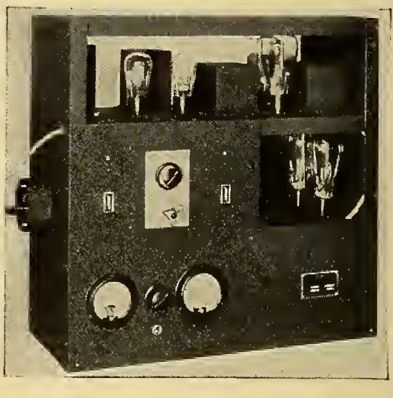
The heavy duty currents required by the projection machine are handled by heavy duty magnetic contactors, of the same type as used in steel mill service. These contactors have magnetic blowouts which reduce arcing, resulting in longer life and lower maintenance costs.

Only the push-button master switch is mounted on the machine, near the operator. The controller proper can be mounted with the resistor in any out of the way place. By simply pushing the "start" button of the master switch, the operator obtains a low current for warming the carbons. Then after a definite time interval, he can transfer to high current for normal projection by pushing the "run" button in the master switch. The definite time interval (about one second) which must expire before the projectionist can transfer from low or starting current to the high running current, assures that the carbons are sufficiently warm and prevents sputtering and its resulting damage to the craters and reflector. The simple control scheme gives the projectionist more time to adjust properly the carbons of the machine, and assures better operation.

The controller proper consists of three magnetic contactors, one of which has a hold-out coil to give time lag between low and high currents. These are mounted on a slate panel in a heavy, sheet metal enclosure. The push-button master switch has three buttons, marked "Start," "Stop" and "Run." Where desired, indicating lights can be incorporated in the push-button master switch to show whether low or high current is on.

New S. O. S. Amplifier

A SOUND-ON-FILM amplifier which eliminates the use of all batteries, chargers, rectifiers, motor generators, and complicated wiring, has just been placed on the market by the Service-on-Sound Corp. of New York City, according to a recent announcement. The new S.O.S. unit is said to solve the problem of unified amplification for theatres wishing to install sound-on-film equipment with the least possible expense and labor. The only additional requirements are a sound head for each projection machine, and the speakers.


The New S.O.S. Amplifier

Among the outstanding features claimed for the new unit are: all AC operation, photocell balancers, volume fader control, changeover switch, jeweled indicators, DC meter, master AC switch, junction box outlets, four stage amplication, exciter lamp supply, non-sync input jack, matched impedance for any sound head or speaker and, of course, the elimination of all batteries.

An Old Spanish Custom

At the recent opening in Bogota of "The Lights of Buenos Aires," starring Carlos Gardel, the audience became so enthusiastic as to demand that a certain portion of the film be repeated. When the management did not immediately accede, the audience threatened to wreck the theatre. The theatre was saved by stopping the film and repeating the scene requested. Audiences in Bogota are noted for their destructiveness when they are displeased with a film, but this is the first time that they have used the same tactics to express their pleasure and demand that a part of a film be reshown.

Theory and Fundamentals

By W. W. JONES

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Engineering Department of RCA Photophone and has been closely identified with the educational activities of that organization since the time of its inception. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that institution.—THE EDITOR.

DC Ammeters and Voltmeters

PRACTICALLY all the DC ammeters and voltmeters used in the projection room contain essentially the d'Arsonval movement, and they differ only in circuit connections and application. Since a knowledge of the construction, principle of operation and application is essential for their intelligent use, these topics will form the subject of the following discussion.

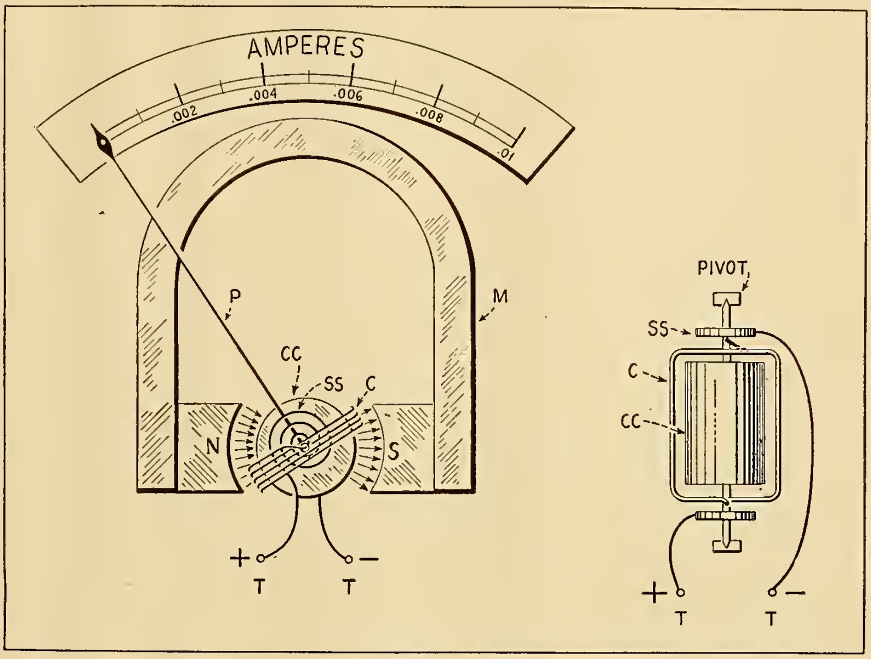


Fig. 1. Details of D'Arsonval Movement

D'Arsonval Movement

A d'Arsonval type movement is shown in Figure 1. The magnetic circuit of this movement consists of a well-aged permanent magnet (M), two soft iron pole pieces (N) and (S), a cylindrical core (CC), and two air gaps located one on each side of the cylindrical core between the core and the soft iron pole pieces.

A coil of fine wire is suspended in the air gap (see inset Figure 1) by means of jeweled pivots so it may rotate freely in the air gap. A pointer needle (P) is fastened rigidly to the coil (c), and this needle indicates on the scale the amount of rotation of the coil in the air gap, or when properly calibrated as described later, will indicate amperes or volts depending on the calibration. Two spiral springs (SS) are fastened to the pivot shafts of the coil (c) in such a fashion as to oppose each other. These spiral springs are used to return the needle (P) to zero when the instrument is not in use; they are used to furnish a torque opposing the movement of the coil, and they are commonly used to conduct the current to and from the coil.

In the magnetic circuit the magnetic flux passes from the north pole (N) through the air gap to the cylindrical core (CC), and then through the second air gap to the south pole (S) where it continues through the permanent magnet to the north pole.

In the electrical circuit of the movement the electric current enters at the positive terminal (T) passes through the upper spiral springs (SS) into and through the coil (C), and then passes out of the coil through the lower spiral spring (SS) to the negative terminal (T).

Action of Meter

The magnetic circuit is so constructed as to produce a uniform magnetic flux in the air gap. When a direct current is passed through the coil (C), it tends to rotate clockwise in the air gap in accordance with the fundamental laws of electro-magnetism. The spiral springs oppose this motion, and the amount of deflection depends upon the strength of the springs, the magnetic density and the amount of current passing through the coil. In commercial instruments it is common practice to adjust the strength of the springs and the magnetic density so that the needle (P) will point to full scale deflection when the current in the coil is 0.01 ampere for meters of certain quality and 0.001 ampere for meters of higher quality.

It is to be observed that in instruments of this type the magnetic flux in the air gap is of uniform density. Since this is true, the deflection of the needle will be proportional to the amount of current in the coil. Therefore, this scale may be graduated uniformly throughout its entire length. It is to be observed further that since the instrument described above reads proportional to current it is essentially an ammeter, and in this case a 0.01 ampere scale or a 0.001 ampere scale ammeter.

It is, of course, true the instrument may be made to operate on as little current as 10 microamperes (0.00001 ampere). However, for this discussion the amount of current required in the coil for operation is of little consequence, except that the amount of current in the coil is one measure of the quality of the instrument. The application of the instrument will determine the quality of the instrument required.

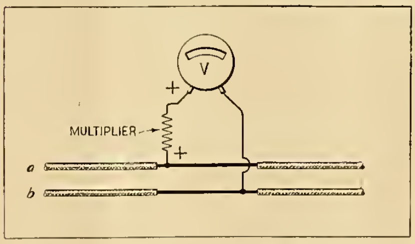


Fig. 2. Voltmeter With Multiplier

The Voltmeter

The d'Arsonval instrument described above was stated to be essentially an ammeter. However, no mention was made of the resistance of the coil (C) in Figure 1. Since the coil has a given resistance, depending upon the size and number of turns of wire used, a certain voltage must be impressed on the coil in order to cause the full-scale deflection current to flow. Also since the current in the coil is proportional to the voltage impressed on the coil, the instrument

(*Continued on page* 37)

Patents:

A series of instructive and interesting articles on how patents are obtained and sold.

By RAY B. WHITMAN

NOTE: *In this series of articles Mr. Ray B. Whitman, practicing patent attorney of New York City, explains in understandable non-technical language just what a patent is, how one is secured and how it may be sold. In addition, Mr. Whitman offers to the readers of this magazine personal advice without obligation on any subject connected with patents, trademarks, designs, or copyrights. All inquiries should be addressed to Mr. Whitman in care of this magazine.*—EDITOR.

How to Sell a Patent

THE first step in the sale of a patent is, of course, to get the patent. Yet, many inventors attempt to market their ideas before filing patent applications on them, or even before having patentability searches made to determine if they are patentable, and in what degree.

The sale of a prospective patent right in this condition is nearly always impossible of accomplishment, since the manufacturer or other prospective buyer wonders why the inventor does not think enough of his invention to spend the small sum necessary to protect it first; and he naturally assumes that the inventor must know it is not an improvement over others, or, if an improvement, then an unpatentable one; and in either of these cases, of course, there would be nothing of value to purchase.

It is well, therefore, to remember that an invention by itself is seldom, if ever, salable. Only a monopoly in the use of the invention—that is, a patent—may be profitably exploited.

The remainder of this series of articles is devoted to a discussion of this little-known but all-important subject, and the methods to follow that have proven most successful.

Testing the Idea

Immediately after the inventor has had his patent application filed in Washington and received the filing receipt as evidence, he should then try to determine just what others in the particular industry think of his invention. This can best be done by submitting it to six or seven different manufacturers of similar products, and noting their reaction to it. If they are all entirely uninterested, it usually indicates that the idea has little or no practical merit.

Of course, some inventions are so revolutionary in character that the normally conservative attitude of manufacturers towards any innovation might induce them all to reject it, even though it later proves to have much merit. Nevertheless, the majority of patented inventions represent only minor improvements over existing inventions, and so the unanimous lack of interest of many manufacturers is a fairly reliable index of their unsalability.

The inventor or patent owner should also, at this time, make inquiries from the retail stores and trade journals, to determine what is already on sale similar to his invention, what advantages his has over the others, whether it would cost more or less to manufacture, and whether its market is extensive enough to be profitably covered. If this analysis is in his favor, he may then take the next step, which is to start the selling campaign in earnest.

The Selling Campaign

The profitable marketing of a patent is one of the most difficult of all selling problems. For it involves not only a technical knowledge of the real patent protection available—which is often beyond the ken of a layman—but also an insight into the needs of the particular industry and the progress of its development to date.

A super sales-skill is required to present the proposition in the most appealing way, and an understanding of the psychology of mind of the prospective purchaser, who is often a shrewd official of a large corporation with considerable experience in such purchases. Then, too, a sale is often aided by personal acquaintance in getting a friendly introduction to the proper official who passes on such matters. Finally, there must be real skill in negotiation work to make a profitable arrangement after the prospect is interested.

Because of all this, and the many pitfalls in the path of the inventor or patent owner, and which may be avoided only with knowledge gained by long experience in this particular work, the inventor who has a patent to sell should, wherever possible, consult with some expert who has behind him a successful patent-selling record, and follow his advice from the beginning to the end of the negotiations.

It is rarely possible, however, for the inventor to turn over the whole task to anyone else, for the sale of the patent then loses its chief assets, namely, the intimate knowledge of the invention and its field of use, which is best known to the inventor himself, and his enthusiasm and close personal interest in getting it on the market profitably.

Most patent buyers prefer to deal directly with the inventor and not through a third party, unless that third party be merely an attorney or agent working with the inventor. To attempt to broker the sale of a patent, as is done with real estate and merchandise, is almost sure to result in failure.

The following rules, if carefully observed, should enable anyone to sell or license a good patent on a good invention, although, as stated, success more often comes from combining the skill, resourcefulness, and successful past experience of an expert, to direct the proceedings and devise the necessary means to complete each deal, with the enthusiastic and persistent efforts and interest of the inventor himself.

Rules for Marketing Patents

First: Don't waste time and money trying to sell the unsalable!

Be sure you have invented something that is substantially better than anything else in its field, fills a real want, can be easily recognized as such, and has no serious drawback to offset partially or wholly its advantages.

Remember that, as a general thing, inventions which save money in the cost of manufacture are more easily marketed than those which improve quality; for those having the former advantage can be definitely so gauged, whereas determining those in the latter class is often a matter of opinion.

Simple inventions are easier sold than the complicated and technical ones, since they involve less initial cost for tools to get the article into production, and hence less financial risk on the part of the manufacturer. Also, the simpler the device or idea is, the wider is its field of use, and so the greater is the amount of business and profit to be had from it.

Second: Get a really strong patent by employing the best attorney you can find.

What attorney's name appears on the drawings of a patent or application is often of much weight with the patent buyer, especially such experienced men as officials of large corporations. They have learned, for instance, to be very wary of patents taken out in the offices of certain well-known advertising attorneys whose business is more of a mail-order character than professional. Such patents are often defective in certain vital respects, either apparent on the face of the patent or hidden in the proceedings during its prosecution, and which defects might later lose an important suit for infringement.

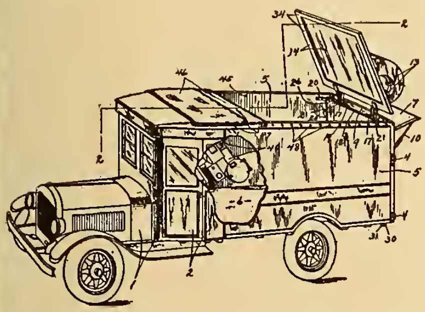
Lucky indeed is the inventor who can set forth on his quest of a purchaser or licensee with a thoroughly good patent, taken out by a good attorney, and having a comparatively large number of claims, some of them short and quite basic in character. If he has such a patent or allowed application, he has already eliminated one

(*Continued on page* 36)

◆ RECENT PATENTS ◆

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 230 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine, and enclosing fifteen cents to cover costs.

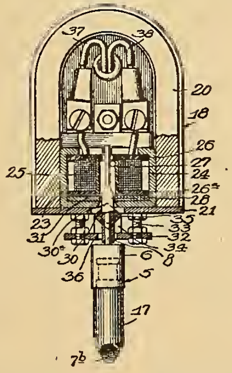
1,832 821. METHOD AND APPARATUS FOR PRODUCING TALKING MOVING PICTURES. EARL I. SPONABLE, New York, N. Y., assignor to Fox Case Corporation, New York, N. Y., a Corporation of New York. Filed Nov. 1, 1928. Serial No. 316,542. 5 Claims. (Cl. 88—16.2.)



5. In an apparatus of the class described, a portable chassis, a substantially enclosed body mounted thereon and having an opening through its top wall, a moving picture projector adapted to project light rays through said opening in said top wall, means for translating a film record of light waves corresponding to sound waves into electrical variations, a loud speaker actuated by said electrical variations to reproduce the original sound waves, a pivotal support for securing said speaker to said body, and means for moving said loud speaker about said pivot into and out of the vehicle body, and a screen in the path of the projected light rays.

▼

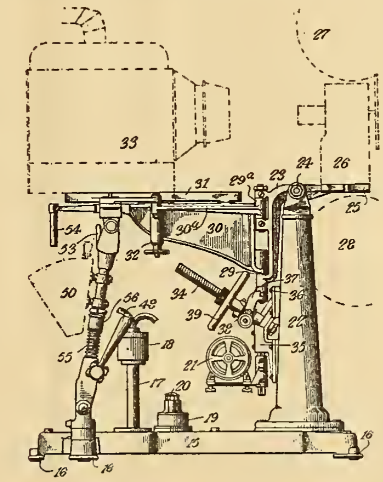
1,829,791. DEVICE FOR RECORDING SOUND ON FILM. HERMAN A. DE VRY, Chicago, Ill., assignor to Q. R. S.-De Vry Corporation, Chicago, Ill., a Corporation of Illinois. Filed Sept. 27, 1930. Serial No. 484,751. 7 Claims. (Cl. 179—100.3.)



1. A device for recording sound markings on a light sensitive moving picture film, comprising in combination a unit adapted to be connected to an electrical system which produces current impulses corresponding to the waves or vibrations of the sound that is to be recorded, and embodying a vibrating element that is actuated by such impulses; means for feeding the film relatively to the unit; and a lamp connected to and vibrated by the element, said lamp being so arranged that when the unit and feed means are operated the light emanating from said lamp strikes against the film and exposes thereon a substantially zigzag or jagged marking.

▼

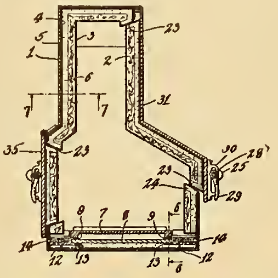
1,831,345. SEMIAUTOMATIC ADJUSTABLE SUPPORT FOR PICTURE-PROJECTING MACHINES. AUGUSTO DINA, Jersey City, N. J., assignor to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed May 31, 1928. Serial No. 281,871. 6 Claims. (Cl. 248—47.)



1. In combination with a motion picture projection machine, a lamp house base, means for pivotally supporting said base, an adjustable frame associated therewith, said frame comprising a pair of telescoping members, springs mechanically interconnecting said members, means for adjusting the tension of said springs comprising a member slidably engaging one of said telescoping members, and a second member threaded thereon and having means associated therewith for seating said spring.

▼

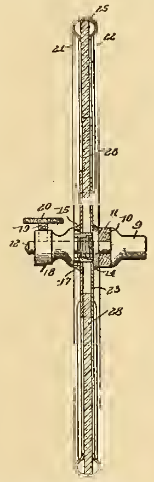
1,931,797. PORTABLE SOUND-PROOF HOUSING FOR MOTION PICTURE APPARATUS. JOHN ARNOLD, Los Angeles, Calif., assignor to Metro-Goldwyn-Mayer Corporation, Culver City, Calif., a Corporation of New York. Filed July 9, 1929. Serial No. 376,887. 13 Claims. (Cl. 88—16.2.)



2. In a portable vibration and sound proof housing for cameras, the combination of an outer metallic housing, an interior lining of fibrous sound absorbing materal, and a metallic sheet between said fibrous material and said outer housing, said metallic sheet being spaced from said housing by means of soft rubber.

▼

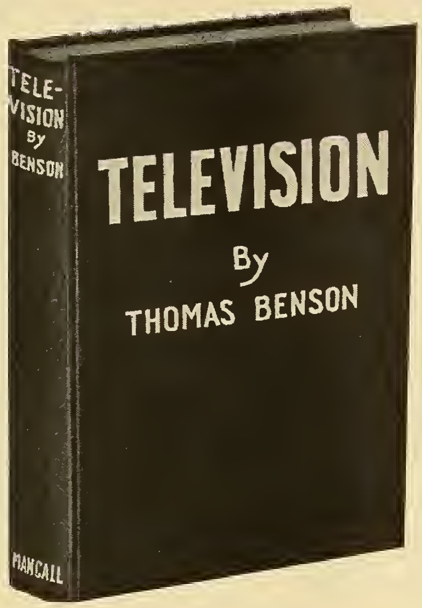
1,830,082. ATTACHMENT FOR CINEMA PROJECTORS. WALTER R. BECKLEY, ALFRED E. CHURCH, and JOSEPH F. MERKEL, Rochester, N. Y., assignors to Beckley and Church Incorporated, Rochester, N. Y., a Corporation of New York. Filed July 27, 1927. Serial No. 208,872. 8 Claims. (Cl. 88—24.)



1. A ray filtering disk for projecting apparatus, embodying a post having a reduced bearing thereon, a hub and a cooperating threaded nut arranged to turn on the bearing, a ray filtering medium clamped between the hub and nut elements and an adjustable sleeve for holding the hub in position on the bearing with varying degrees of frictional resistance to rotation.

2. A ray filtering disk for projecting apparatus, embodying two opposite sections comprising circumferential rim portions and comparatively narrow radial spoke portions fastened together, and a plurality of filtering mediums of segmental shape held between the sections.

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today. It is a book both for the interested layman and for the craftsman who will shortly depend on television operation for his livelihood. It has been written especially for the motion picture projectionist who will unquestionably operate television in the theatre as he now does sound equipment. The serious projectionist will get a copy at once.

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

TELEVISION
By Benson $2.00

SEND THIS COUPON TODAY
Mancall Publishing Corp.,
7 West 44th Street, New York City
Enclosed find money order for $2.00.
Please send me Benson's Television.

Name ....
Address ....
City and State..............................
Theatre ....

Patents

(*Continued from page* 34)

of the chief obstacles in the way of a successful sale. For it is true that a great many patents on useful inventions fail to sell because of a lack of adequate patent protection, since most anyone can devise a way to avoid their claims by making some slight change in the invention, and which not only would not detract from its effectiveness or salability, but might indeed in many instances actually improve it.

Third: Obtain an attractive working sample of the invention.

It is amazing how seldom does the patent seller realize the absolute necessity of providing himself with an attractive working model or sample of his invention before attempting to market it. He feels the patent itself is sufficient, and that its drawings take the place of a working sample; and he burdens the prospective purchaser with trying to determine by this means if it will work successfully.

This is one of the most serious mistakes made by owners of patents, and results usually in failure, since the bona fide patent buyer nearly always insists upon being shown. So, have a good model or working sample made, and then, if necessary, another and yet another, until it functions perfectly, and is just about an exact duplicate both in appearance and operation of what would be sold to the trade.

(*To be continued*)

Outline of Sound Recording

(*Continued from page* 31)

produce the proper illusion the microphone must be rather close to the players and if the players move, it must move along with them. To allow such motion the microphone is mounted upon a boom (Fig. 20). By means of the cranks near the standard, the microphone may be run out along the boom, the boom may be rotated around the standard and the end of the boom raised and lowered, thus making it possible, without moving the boom itself, to place a microphone in any position within a fairly large radius.

Previous to the actual "take" the director will have rehearsed the actors in the particular scene and make sure that they are both letter perfect and action perfect. That is, they should be; but in many cases it is found that during the actual "take" the microphone affects some actors in the same way that an audience affects the inexperienced speaker; and also, accidents will happen, so even with a perfect rehearsal more than one "take" may be required.

Rehearsal Procedure

During one of the rehearsals, usually during all of them, although no record is made, the monitor listens to the sound. After a rehearsal is over he instructs the sound man on the stage how to place the microphone, and tells the director about noises (due to motion of the actors), words unintelligible and such faults as the actors turning their faces too far from the microphone as to make their speech unintelligible. This question of clarity and intelligibility of speech is a very important one since in order to compress the play into eight or nine reels and have sufficient time for action, the spoken words must usually be heavily pruned. Therefore, every word must be clearly understood by the audience if they are not to lose interest in the story.

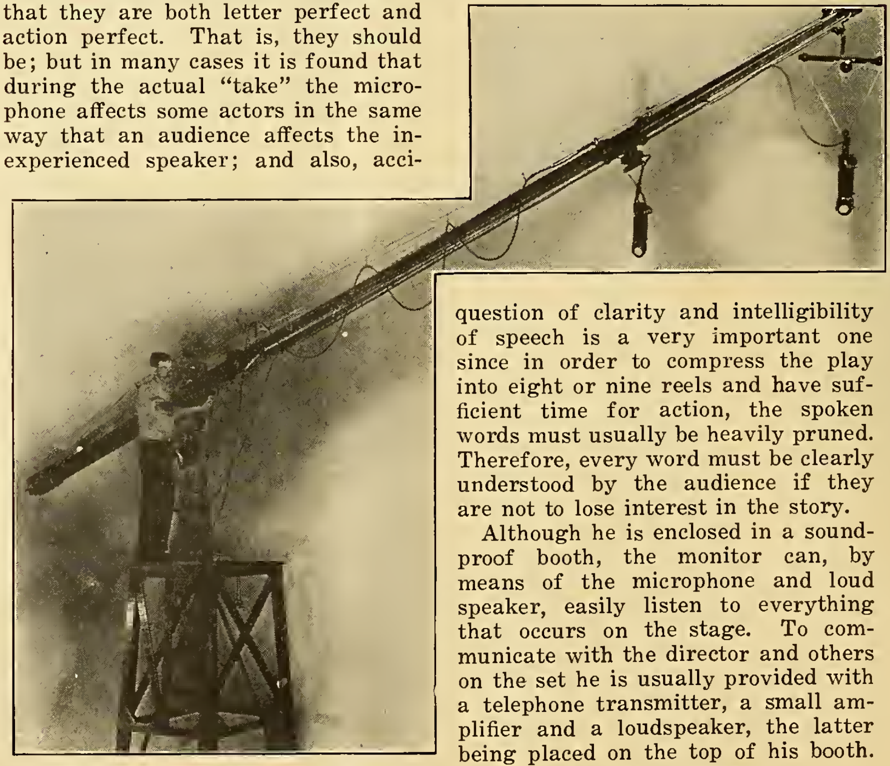


Fig. 20. *Microphone Boom*

Although he is enclosed in a soundproof booth, the monitor can, by means of the microphone and loud speaker, easily listen to everything that occurs on the stage. To communicate with the director and others on the set he is usually provided with a telephone transmitter, a small amplifier and a loudspeaker, the latter being placed on the top of his booth.

(*To be continued*)

Theory and Fundamentals

(*Continued from page* 33)

may be calibrated as a voltmeter as well as an ammeter.

As an example, assume an instrument having a full-scale deflection current of 0.001 ampere. This value of current can usually be determined from data on the dial of the meter. In this case the dial would be marked 1000 *ohms per volt*, which means that one volt is required for every 1000 ohms in the moving coil circuit. The full scale deflection current can then be calculated from this data by Ohm's Law as follows:

$I = 1 \text{ volt}/1000 \text{ ohms} = 0.001$ ampere.

Usually the resistance value of the movement is marked on the face of the dial. For this particular instrument the resistance of the coil is assumed to be 50 ohms. From this the full-scale voltage required from Ohm's Law is

$E = IR = 0.001 \times 50 = 0.050$ volt.

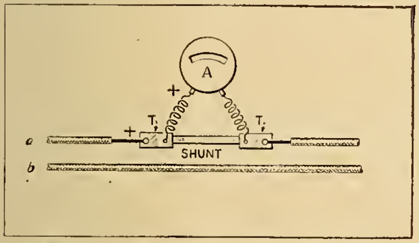


Fig. 3. *Ammeter With Shunt*

The full-scale value of 0.050 volt means a full-scale deflection of the meter needle can be obtained when 0.050 volt is impressed on the moving coil. Now if the dial on the instrument in Figure 1 be changed in calibration, to 0 to 0.050 the instrument could be used as a 0 to 0.050 voltmeter. Thus we have one instrument which may be used as either an ammeter with a range of 0 to 0.001 ampere, or a voltmeter with a range of 0 to 0.050 volt.

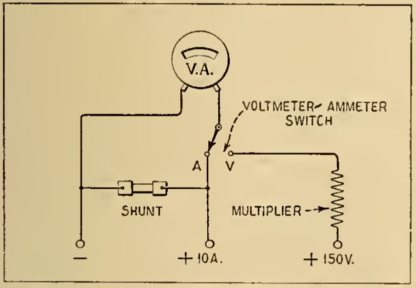


Fig. 4. *Volt-Ammeter Connections*

Voltmeter Multipliers

Since a voltmeter in use is placed across the line as indicated in Figure 2, it consumes current from the line. It is, therefore, necessary when measuring voltages, particularly in amplifier circuits, that the resistance of this voltmeter be as high as possible or the current consumed by the meter be as low as possible. An instrument suitable for this work is usually a 1000 ohm per volt instrument.

The instrument described above under the heading "The Voltmeter" is a 1000 ohm per volt instrument, and is limited in use for voltages up to 0.050 volt. This same instrument, however, can be used for any voltage greater than 0.050 volt provided a suitable multiplier (M) is placed in the meter circuit in series with the voltmeter as shown in Figure 2.

The procedure for selecting the proper multiplier follows:

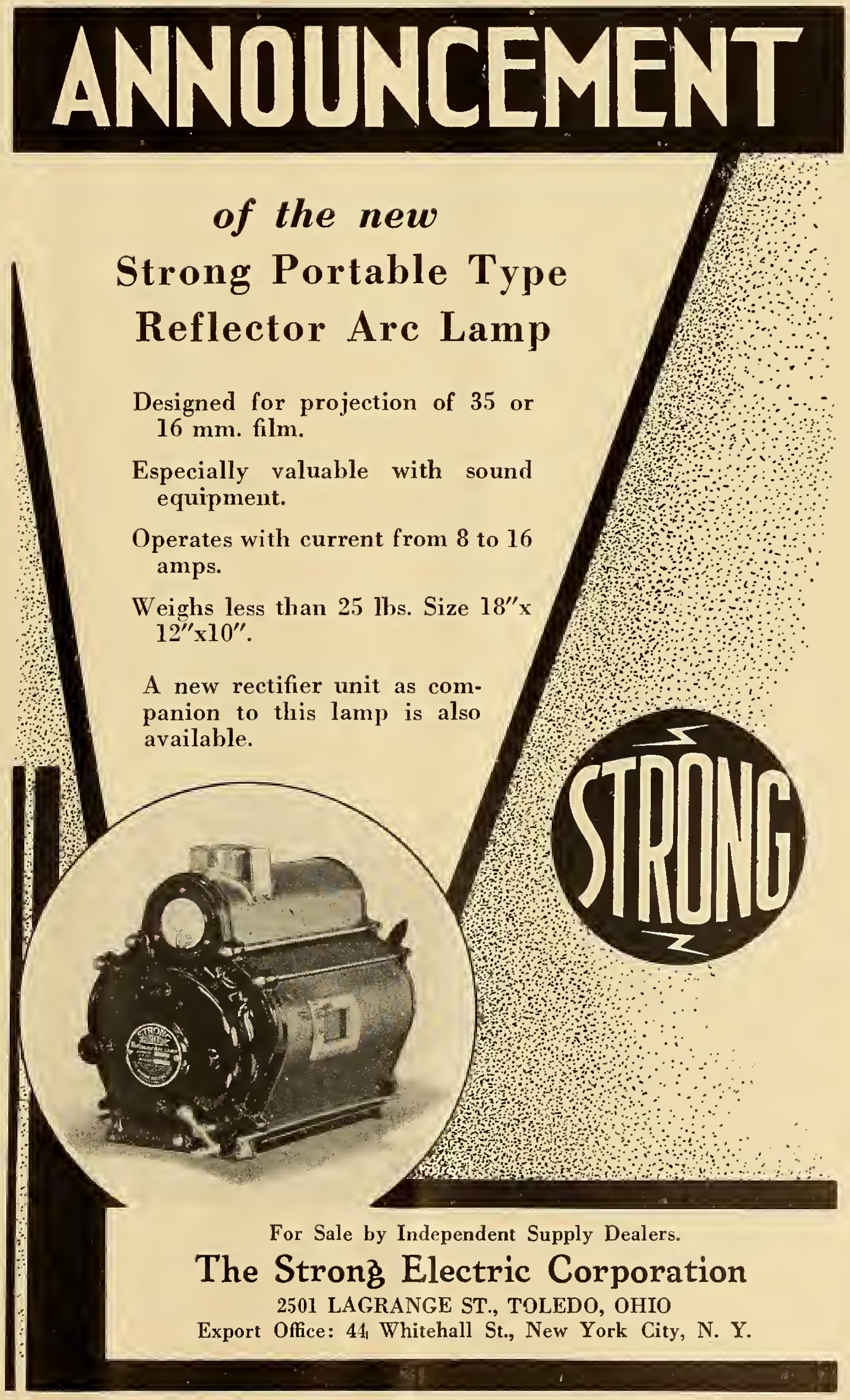
The instrument has a full-scale deflection current of 0.001 ampere. Assume it is desired to have the instrument operate on a 120 volt circuit. This would require a full-scale deflection of at least 150 volts. The total resistance in the voltmeter circuit for 0.001 ampere at 150 volts from Ohm's Law is,

$R = 150/0.001 = 150{,}000$ ohms.

Since the meter coil itself already has 50 ohms resistance, it is necessary to add in the form of a multiplier (M) 149,950 ohms, making a total of 150,000 ohms.

The multiplier should be made of a high grade of wire so that it will not change in resistance value when the multiplier heats or cools. Multipliers usually are wound on a little spool or bobbin and contained within the case of the instrument.

An ammeter is connected in series with the apparatus, or the line in



ANNOUNCEMENT

of the new

Strong Portable Type Reflector Arc Lamp

Designed for projection of 35 or 16 mm. film.

Especially valuable with sound equipment.

Operates with current from 8 to 16 amps.

Weighs less than 25 lbs. Size 18"x 12"x10".

A new rectifier unit as companion to this lamp is also available.

For Sale by Independent Supply Dealers.

The Strong Electric Corporation

2501 LAGRANGE ST., TOLEDO, OHIO

Export Office: 44 Whitehall St., New York City, N. Y.

which the current is to be measured as shown in Figure 3. Since an ammeter is connected in series with the circuit, a good ammeter should offer as little resistance as possible. An ammeter shunt is used to change or extend the range of the instrument. The shunt usually consists of a metal bar having low resistance and provided with terminal blocks (T) as shown in Figure 3. Often the shunt (S) may consist of a spool of wire. In either case the shunt, as the name implies, is shunted across (connected in parallel with) the instrument.

For purposes of discussion, let it be required to extend the range of a d'Arsonval movement for use in measuring current in a circuit up to 50 amperes. The range of a movement may be extended to any value by providing it with the proper shunt (S) as shown in Figure 3. It will be observed the shunt (S) is connected in line (a) of the circuit (a) (b). The ammeter movement (A) is connected to the terminals (T) of the shunt.

The ammeter movement (A) selected in this case will be identical with that used in the discussion under the heading "Voltmeter Multipliers." That is, the ammeter movement will have a full-scale deflection current of 0.001 ampere, or voltages of 0.050 volt.

Since it is desirous to have practically all of the current pass through the ammeter shunt (S), its resistance value will be calculated so that the voltage drop on the shunt is 0.050 volt when 50 amperes pass through the line (a). The resistance of the shunt then is:

$$R=0.050/50=0.001 \text{ ohm.}$$

The above procedure may be considered correct where the line currents are high compared to the current required to operate the instrument, which in this case was 0.001 ampere.

As a further example, let it be required to calculate the resistance of a shunt for the above movement to measure currents up to 0.01 ampere, and take into account the current consumed by the meter.

There will be 0.01 ampere in line (a) Figure 3. The meter will take 0.001 ampere and the shunt (S) will carry 0.01 minus 0.001 or 0.009 ampere. The voltage required for full-scale deflection is 0.050 volt. The resistance of the shunt (S) then is:

$$R=0.050/0.009=5.56 \text{ ohms.}$$

Shunts for small instruments up to 50 amperes are usually contained in the ammeter case, while instruments of larger capacity have their shunts located externally. It is quite common in the case of some manufacturers to supply instruments with a set of external shunts which may be used in connection with the instrument for various ranges. Shunts as well as multipliers should be made of a material which does not change in

STILL PREFERRED

Above All Others

MORE Miehling books have been sold to projectionists than any other . . . . There have been others since Miehling's book was brought out . . . . and some at a lower price . . . . but Miehling's still remains as the *only book written by a projectionist for prejectionists* . . . . That it why it is so overwhelmingly popular.

In this book you will find a thoroughgoing explanation of the fundamentals of *all* sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.
519 pages . . . completely indexed

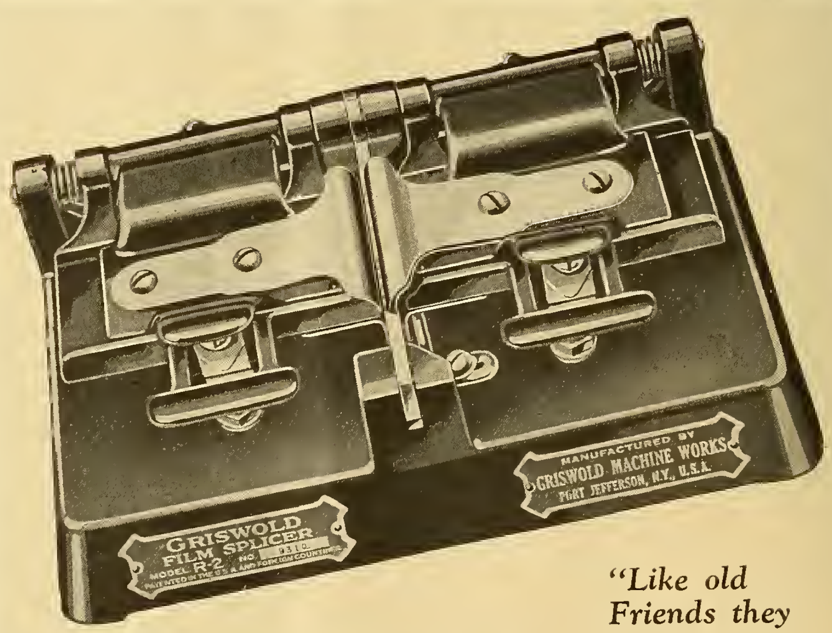
THIRTY-ONE chapters, each covering a phase of sound equipment operation, are thoroughly indexed in the back of the book, affording the projectionist full means of reference in case of trouble. The whole set-up of the book has been designed for leisurely reading or for quick use in a breakdown emergency.

ONE hundred and thirty-seven illustrations: diagrams, schematic drawings and photographs are scattered through the book, adjacent to connecting text. Continuity of text and picture is thus preserved throughout. A perfect book for projectionists.

Price $4.00, We Pay Postage

Mancall Publishing Corp.,
7 W. 44th Street, New York City
Send me Miehling's Sound Projection. Enclosed find remittance of $4.00.

Name ....
Address ....
City and State....................................
Position ....
Theatre ....



"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS
Port Jefferson, Long Island New York

resistance when subjected to heat or cold.

In the above discussion it has been pointed out how the same instrument movement could be used for either an ammeter or a voltmeter by selecting the proper shunts or multipliers as the case may be. Figure 4 shows an arrangement whereby one movement contained in a case may be equipped with a shunt and a multiplier with connections brought out to terminals suitably marked for identification. In using this instrument as an ammeter, for example, the connections would be made to the terminals marked (+10A) and (—), and as a voltmeter connections would be made to terminals marked (+150v) and (—). The designation (+10A) means plus terminal 10 ampere range, and (+150v) means plus terminal 150 volt range.

Circuit arrangements other than those suggested in Figure 4 are used by instrument manufacturers. For example, a voltmeter or ammeter may be made up with a dial switch to connect different values of shunts and multipliers in the circuit for the various ranges.

As an example of the extended use of the principles outlined above, certain manufacturers of radio broadcast equipment and sound motion picture equipment supply only one meter on the amplifier racks. This one meter is equipped with a telephone type plug which is inserted into jacks located in various circuits of the amplifier. Those jacks used for current measurements are fitted with proper shunts, and those for voltage measurements are fitted with proper multipliers. Since each jack is fitted with its own shunt or multiplier, the scale reading on the meter depends upon the jack into which the meter plug is inserted.

Projection on High Seas

(*Continued from page* 20)

by the fact that the ship's crew doubles in brass in operating the equipment. The Chief Electrician, who is a ship officer, and his assistant, function as stage hands and projectionists. Prior to the maiden voyage they were instructed in the operation of the apparatus by the engineer under whose supervision the installation was made, with the aid of an instructing projectionist.

As an added assurance these men sailed on the maiden voyage to supervise and assist in the initial operation and maintenance of the equipment.

The program to date has called for four shows on each round trip, one every night that the ship is on the water. It is necessary to trim the lamps only at the end of the voyage, an important feature in considering the amount of work devolving upon the projectionist while the boat is sailing.

The Distribution Voltage on the

HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.

H&C INC.

SUPER-LITE
SHORT FOCUS
HALF SIZE
LENSES

Increase Illumination
50%
In Comparison With
Quarter Size
Lenses
4" EF. to 8" EF. Sizes

PROJECTION OPTICS CO., Inc.
330 Lyell Avenue
Rochester, N. Y. U. S. A.

Hoffmann-Soons

PERFECTION

What's in a Name?

How many times have you heard that question asked before? Perhaps a thousand times and yet it was never taken seriously. Why? Because it had nothing to do with your theatre. But today with upset conditions and competition right next door to you—it means everything—yes, even the future of your business.

That's why when you install a PERFECTION RHEOSTAT you attain the best projection results that insure the future prosperity of your theatre.

A good name enjoys the full confidence of those who believe in it. We are happy to have this confidence which has been evidenced by hundreds of theatre owners.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

Sold by all Branches of NATIONAL THEATRE SUPPLY CO., SAM KAPLAN, NEW YORK, CONTINENTAL THEATRE ACCESSORIES, and by your dealer.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue, Mfg. Division, New York
Contracting Electrical Engineers
Moving Picture Theatre Electrical Specialists

RHEOSTATS

SOUND REELS

For Perfect Projection

ALL-WELDED TYPE
One Unit

LASTING DURABILITY
Bright Cadmium Plated

—All Sizes—

DEMOUNTABLE TYPE
Each side one unit

ALL PARTS REPLACEABLE

Write for quotations

UNIVERSAL ELECTRIC WELDING COMPANY
9-16 Thirty-seventh Ave., Long Island City, N. Y.

Give This to Your Friend—Have Him Fill It in and Mail to us at Once

The Motion Picture Projectionist
7 West 44th Street, New York City

Gentlemen:

Enclosed please find $2.00 for which enter my subscription for one year (12 issues) starting with..............................issue. (Two years, $3.00.)

Add 50 cents for Canadian postage; $1.00 for foreign.

Name ....

Street ....State ....

City ....Local No..................................

ship is 220 D.C., and this necessitated the use of a balancer set to provide the 110 D.C. voltage required to operate the sound picture equipment.

Equipped for the satisfactory presentation of talking pictures, the *Monarch of Bermuda*, which inscribes QTDV (Quadruple Screw Turbine Driven Vessel) on its stationery, lays claim to offering seagoing travelers all the comforts and entertainment features they might find in the midst of the most luxurious pleasure colony on shore.

Horns and Their Purpose

(*Continued from page* 24)

It is needless to state that materials which are not weather-proof are not suitable for horn manufacture. From an acoustical point of view, concrete, steel, white metal or plaster paris are all very good. Inasmuch as horns must be successfully shipped, however, lighter materials have been used. Well-seasoned wood, highly polished, is an excellent horn material, as is also masonite, a wood composition made under very high pressure on highly polished steel dies, which produces a highly polished surface and a wall of uniform thickness and high density.

Figure References

Fig. 1. Six Foot Trumpet. Air column 72 inches, bell 27 inches by 27 inches, cut-off frequency 120 cycles. A square bell such as that shown provides an area 27 per cent greater than a round bell of the same width, and is besides more compact than the latter.

Fig. 2. Twin Tone Arm Trumpet. Initial diameter of each tone arm ⅝ of an inch, length 68 inches, bell 27 inches by 27 inches. Used to obtain high concentration of energy in a small area or a narrow beam.

Fig. 3. Triple Trumpet. Initial diameter ⅝ of an inch, length 6½ feet, bell 27 inches by 27 inches, effective angle of spread 85 degrees. Used to distribute energy over a wide area.

Projector Drive Motors

(*Continued from page* 13)

cuits the resistor, full field current and hence field strength is obtained, and the motor runs at its slowest speed. If the switch opens the field strength is decreased and the motor speeds up. In practice, the centrifugal switch consists of a spring strip having a weight at each end and a contact in the center. This assembly rotates with the shaft and the weights fly apart as the speed increases, thereby pushing the contact towards a stationary contact, which latter screws into the end bell of the motor and thus can be adjusted to move closer or farther away from the other rotating contact. The farther away the stationary contact is from the rotating one the higher must be the armature speed before they touch. When this occurs the field resistance is shorted out and full field strength is obtained.

How It Operates

Hence, in operation, the armature speeds up until the contacts touch, whereupon it slows down. This causes the contacts to open, whereupon the armature speeds up again. Therefore, the armature is constantly speeding up and slowing down, but, with a properly designed governor, this variation in speed can be kept within the limits which would be perceptible to the ear as a change in pitch. Constancy of speed is further aided by mounting a flywheel on the armature shaft.

One further point is to be noted. If the stationary contact is separated from the rotating one by a greater distance the armature must speed up to a higher value before the contacts will begin to make and break and thereafter the armature revolves at this new, higher speed. In this way various *constant* speeds may be obtained.

The governor is therefore necessary here to obtain absolutely constant speed and also to obtain adjustable speed operation. Indeed, the latter is the more important justification for the governor, for, as mentioned previously, an electric motor can readily be designed to maintain practically constant speed for various loads.

Recapitulation

We have thus seen that:

(1) An induction motor makes use of a revolving field, in which is placed a rotor having a series of short-circuited conductors and which rotor tends to follow and rotate nearly as fast as the revolving field.

(2) The projector synchronous motor is an induction motor whose rotor iron structure is so designed as to lock magnetically with the revolving field, after which the rotor revolves at synchronous speed.

In either of the above cases the speed is determined mainly by the frequency. The latter is always maintained practically constant, so that there is no need for any governor mechanism. Moreover, there is no simple satisfactory way of utilizing such a governor in conjunction with either of the above two motors to obtain adjustable speed operation.

(3) The D.C. motor makes use of a commutator, which is a kind of reversing switch and which reverses the direction of the current through the armature conductors as they move from one field pole to the next. In addition, use is made of a centrifugal switch or governor for the purpose of maintaining practically constant yet adjustable speed by control of the field current.

SYNCROFILM MODEL "B" SOUND EQUIPMENT

Weber Machine Corp. was first to recognize the needs of the small theatre for a first class sound equipment equal to the best, but at a price in keeping with its abilities to buy and still keep reasonably on the black side of the ledger.

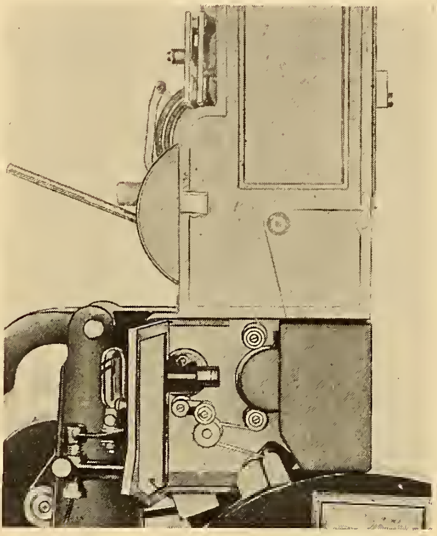
Weber Syncrofilm quality has been recognized from the very beginning. It is among the leading sound equipments, yet is sold at a low price and absolutely free of all extra charges, such as service, fees, etc.

Model "B" is the most advanced. It is already in daily use in hundreds of theatres throughout the country.

$275.00 per pair

Weber Machine Corporation
59 RUTTER STREET
ROCHESTER, N. Y.

Export Department:
15 Laight St., New York City
Cable: "Ariab," New York



for
TRUE and LIFELIKE REPRODUCTION
use "TELEPHOTO" Photoelectric Cells

The Caesium-Argon Cell of QUALITY. End your cell worries by adopting "TELEPHOTO" as your standard equipment.

WRITE for Pamphlet No. 5 and prices.

Telephoto & Television Corp.
133-135 West 19th Street, New York City

KEEP all your COPIES of
MOTION PICTURE PROJECTIONIST
AS A REFERENCE FOR CURRENT AND FUTURE NEEDS—PRESERVE THEM IN A BINDER

BINDERS

$2.00 each

GOOD SOLID IMITATION LEATHER —GET ONE

ORDER FROM THE MOTION PICTURE PROJECTIONIST

Good Projection Requires Good Rectification

M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes, then the other two, as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP.
New and Wilsey Sts.
Newark New Jersey

Index of Advertisers

Bausch & Lomb 6
Brenkert Light Proj. Co. 4

Chalmers Publishing Co. 42

Eastman Kodak Co. 5

Fish-Schurman Corp. 5
Forest Electric Corp. 42

General Machine Co. 6
G-M Laboratories 42
Griswold Machine Works 38

Hall & Connolly, Inc. 39
Hoffmann-Soons, Inc. 40

International Projector Corp., Back Cover

Kaplan, Sam, Mfg. & Supply Co... 2

McAuley, J. E. Mfg. Co. 7
Movie Supply Co. 42

National Carbon Co. 3
National Theatre Supply Co. 43

Projection Optics Co. 39

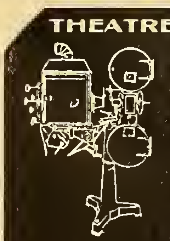
Roth Bros. 8

Service-On-Sound Corp........... 42
Strong Electric Corp. 37

Telephoto & Television Corp. 41

Universal Electric Welding Co. ... 40

Weber Machine Corp. 41

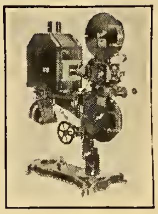


THEATRE EQUIPMENT
NEW AND USED

Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.

Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
OVIE SUPPLY CO.. 844 So. Wabash, Chicago

To-day's Money Maker is Selling
Portable Sound-on-Film
to Theatres, Schools, Churches, Clubs

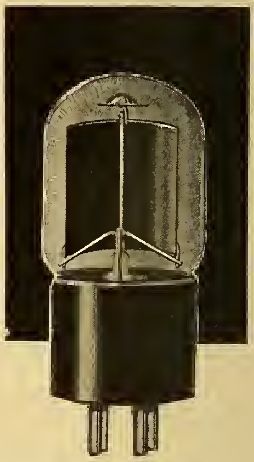


Write for manufacturers' prices on Soundheads, Photocells, Optical Systems, Rectifiers, Amplifiers, Horns, Faders, Synchronous Motors, Projectors, Lamphouses, Screens, Michrophones, etc.

S. O. S. CORPORATION
Dept. M. P.—1600 Broadway
New York City
Cable: "SOSOUND"

What

You need for better SOUND



PHOTOELECTRIC CELLS
VISITRON
REG. TRADE MARK

Produced by the pioneer manufacturers of photoelectric cells for talking pictures. Sold and serviced by National Theatre Supply Company.

G-M LABORATORIES INC
1733 Belmont Avenue Chicago, Ill.

INSURE YOUR JOB!
Study F. H. Richardson's
Handbook of Projection

Three volumes containing over 1,400 pages of vital knowledge with question and answer index. Every projectionist needs this authoritative guide. See your local theatre dealer or send for full details.

CHALMERS PUB. CO.
516 Fifth Ave., N. Y.

FOR YOUR OWN

Protection . . . . . .

demand

GENUINE
Repair Parts

The projectionist who insists on genuine repair parts for the maintenance and repair of his equipment is wise. It's a safe plan to follow. The projectionist is, or certainly should be, responsible for results in the projection room. He takes a long chance when he repairs with bootleg parts, which have been known to seriously affect the performance of the entire mechanism. Play safe and fair with yourself, your employer and the manufacturer by always saying "No" to the seller of spurious parts

For your convenience National keeps a large stock of GENUINE repair parts on hand all the time. Day or night service—right at your telephone.

NATIONAL THEATRE
SUPPLY COMPANY
Branches in all Principal Cities

REPLACE WITH Simplex PROJECTORS
TRADE MARK REG'D.

MILLIONS ARE LOST
EVERY YEAR
THROUGH FILM MUTILATION

WHICH COULD BE SAVED
BY SPENDING A FRACTION
OF THE MONEY FOR

NEW Simplex PROJECTORS
TRADE MARK REG'D.

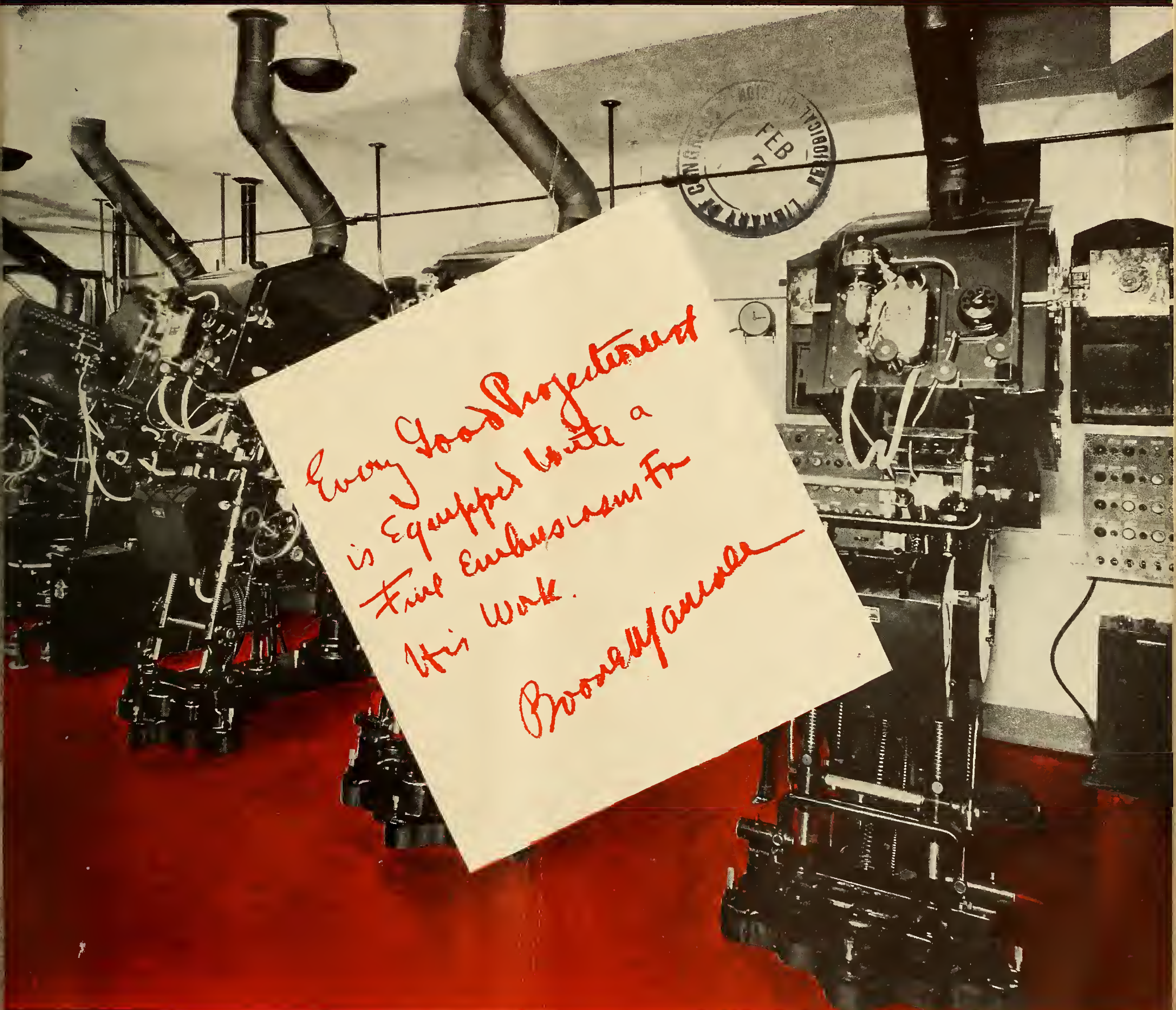
OR

REASONABLE REPAIRS
WITH
GENUINE Simplex PARTS

INTERNATIONAL PROJECTOR CORPORATION
90 GOLD STREET NEW YORK

REPAIR WITH GENUINE Simplex PARTS
TRADE MARK REG'D.

MOTION PICTURE PROJECTIONIST



Every Good Projectionist
is Equipped with a
Fine Enthusiasm For
His Work.

Boone Mancall

LIBRARY OF CONGRESS
FEB

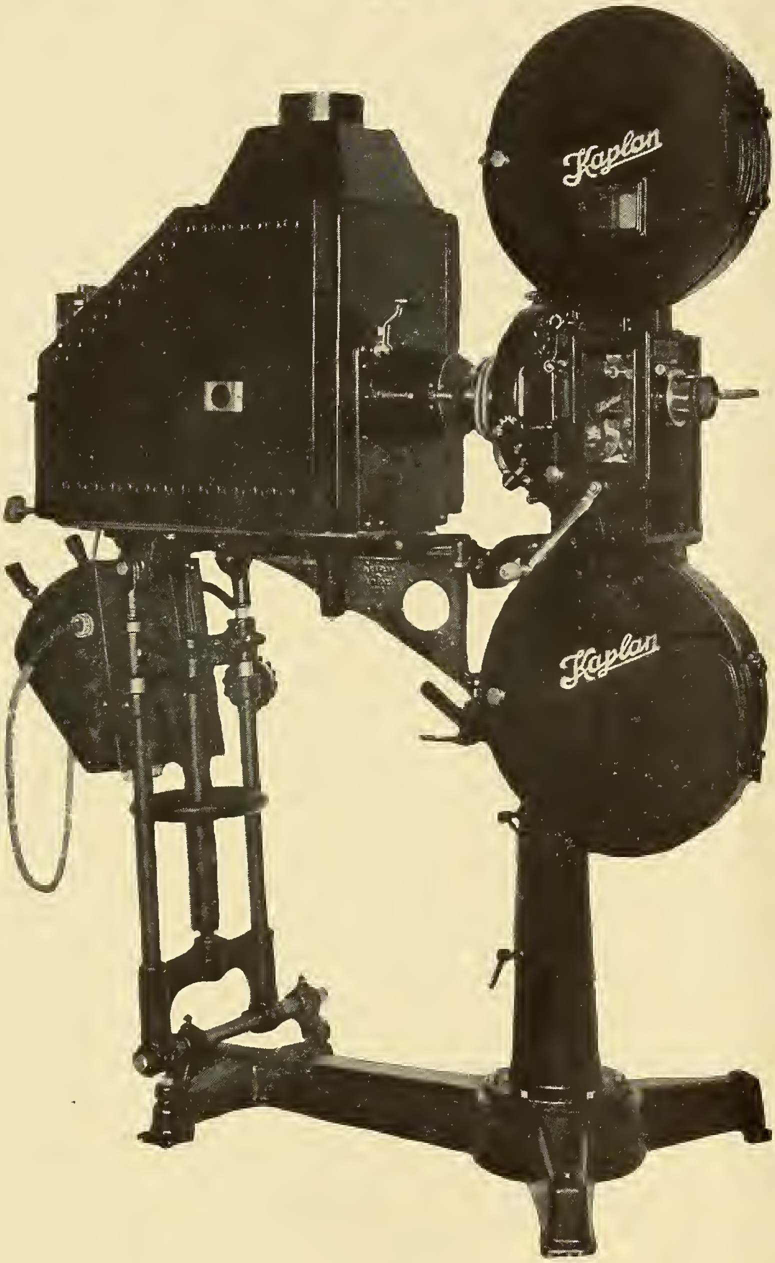
Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.*
Editorial and Advertising Offices, 7 West 44th Street, New York City
Entered at New York Post Office as second class matter, October 25, 1927

Vol. 5 • No. 4
25c per copy $2 per year

February, 1932

FIFTH YEAR OF PUBLICATION

Kaplan



PROJECTOR

The Kaplan Projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

An Engineering Product

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue -:- -:- New York City

MOTION PICTURE PROJECTIONIST

February, 1932 Vol. 5, No. 4

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Mortimer Glancoff

Editorial & Advertising Office
7 West 44th St.
New York City.

RCA Photophone-RCA Victor Consolidation Announced

As a further step in the unification of activities of the Radio Corporation of America in the radio and electrical entertainment fields under the RCA Victor Company, Inc., at Camden, N. J., David Sarnoff, president of the Radio Corporation of America, has announced the consolidation of RCA Photophone, Inc., with the RCA Victor Company.

The unification, Mr. Sarnoff stated, joins two closely associated lines of radio and electrical development. It will mean a closer association of sound motion picture recording and reproducing with the radio laboratory and should give impetus to the introduction of sound reproducing equipment for use in homes, schools and industrial organizations, as well as in theatres.

Both companies involved in the unification are wholly owned subsidiaries of the Radio Corporation of America. The staff of the RCA Photophone Company as well as the operations of that company are being transferred to the RCA Victor Company at Camden, New Jersey.

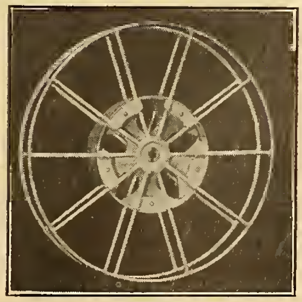
THAT EXTRA OUNCE OF SCREEN QUALITY

WHEN you run across a picture that screens with particular excellence—that especially satisfies audiences—that makes people pass along the good news—the chances are that it was made on Gray-backed Eastman Super-sensitive Negative. For this improved ultra-speed film, pioneered by Eastman, gives that extra ounce of screen quality that frequently distinguishes the very best picture from the merely good. Eastman Kodak Company. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN *SUPER-SENSITIVE*
Panchromatic Negative (*Gray-backed*)

SOUND REELS

Professional
16Mm. 7" 400 ft.,
35Mm. 10, 11, 14, 15"
for 1000 and 2000 feet.



All Welded
and
Demountable
Types
Cadmium Plated

Patented

WILL OUTLAST ANY OTHER REELS
UNIVERSAL ELECTRIC WELDING CO.
9-16 Thirty-Seventh Avenue Long Island City, N. Y.

Performance Counts

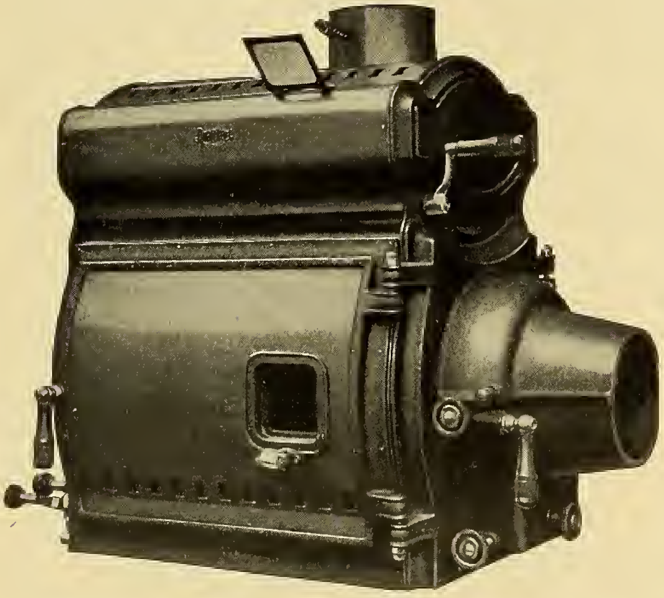
Brenkert

SUPER HIGH INTENSITY PROJECTION LAMPS

Are preferred and used in theatres from coast to coast.

CORRECTLY ENGINEERED AND CAREFULLY BUILT

A Demonstration Is Convincing



Distributed by Progressive Independent Supply Dealers

Ask Any User

A Brenkert PRODUCT

Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

The S.M.P.E. and the Projectionist

MANY projectionists are unaware of the extent to which the various committees of the Society of Motion Picture Engineers pursue their studies in matters which are of vital importance to the man in the projection room.

Motion picture engineering is perhaps the most comprehensive of all branches of engineering, embracing as it does the technology of acoustics, of the transmission of sounds over systems of various kinds, of mechanical engineering and design, of optics, of photoelectricity and photochemistry, of architectural design and the construction of auditoriums, and illumination of auditoriums and studios. In short, it demands of the well-rounded motion picture engineer a good working knowledge of many subjects which at first thought seem hardly akin to the motion picture projected on the screen.

Experience and research teach us how to bridge across the gaps between the unrelated matters of fact; sooner or later our store of knowledge of the facts enables us to perceive the relations that exist among them; and ultimately we learn that all those facts which were formerly isolated fragments of learning can be joined together into a single general statement which is at once expressive of all.

When such a process is accomplished it is possible to deduce from the generalized statement all the individual facts that called it into being; and not only that, but many facts which were not realized before, but which, unknown to us, occupied the gaps between the facts that we did know, will be deducible from the general statement with a considerable degree of justification.

It is the function of the technical committees of the S.M.P.E. to make complete studies of many of the problems the details of which are known but incompletely, not only by the projectionist but even by the engineer himself. These committees function for the purpose of discovering the missing links in the chains of fact, so that the process of reasoning from one end of the chain to the other may be continued, and will present no gaps of knowledge to cross which assumptions must be made without proper justification.

The amount of information suggested by the various phases which enter into the operation of a theatre is enormous; it is a practical impossibility for any one individual to acquire so comprehensive a knowledge of all these things as would be necessary for the complete solution of the projectionist's problem. However, by properly dividing the many subjects of study among groups of men peculiarly fitted for the particular subject, much of this disadvantage can be overcome.

For example, the Projection Practice Committee of the S.M.P.E. is composed of men who are peculiarly adapted to study the problems of the projector and the projection room. The recommendations of this committee, based on their study of the requirements to be met for projecting pictures of the highest quality with a given film supplied by the studios, are matters worthy of serious study.

So with the Projection Theory Committee, dealing with ocular fatigue and the optics of projectors; so with the many committees which anticipate the problems of projection, and deal mainly with the problems of supplying for projection the kind of film that the exhibitor wants to project.

The projectionist's interest ought to extend, so far as is possible and the press of routine duties in the theatre will permit, beyond the projection room and into the laboratory and studio.

Of inestimable value to him in this respect is the Report of the Progress Committee, rendered bi-annually, which traces the paths of progress marked out in the various phases of motion picture engineering during the half year preceding.

As The EDITOR *Sees* IT

¶ *In the Projection Room*

THE projectionist who does not take an interest in his work is much to be pitied. Aside from the fact that he can expect little in the way of worldly advancement, he is missing one of the few pleasures that life has to offer.

Man must work or perish. It is one of the fundamental laws of Nature. One may as well accept the inevitable with the best grace possible. By far the more important, if not the greater part of the average individual's waking hours, are spent in the pursuit of some trade or profession. If this time is to be passed in loathing for the task to be accomplished, then life for that person means little more than a span of weary servitude.

But work can be interesting—if we make it so. It can be a pleasure—a really great adventure. This is doubly true in the case of the projectionist. His work of itself possesses a fascinating interest. Its ramifications are endless. Back of the routine of threading and rewind there is a field as broad as the stars.

Think of it! Light, optics, color, sound, mechanics, electricity, chemistry and mathematics—every conceivable branch of science has something to contribute. Each branch in itself is a life study, but the man behind the projector must know at least a little something about them all.

Nor is this knowledge static. Something with which to store the brain, as with so much mental lumber. The field is in a continuous state of foment, development and progress. Before us today is the dim vision of distant goals. Their attainment requires an ever-increasing store of knowledge. The projectionist who wishes to stay in the game must move with the times. The more he knows the greater his earning power and his capacity for enjoyment in his work.

¶ *The Aperture Question*

THE aperture question is still with us. In our December issue we published the proposal of the Academy of Motion Picture Arts and Sciences concerning the matter. Our present issue carries an article by Mr. Sylvan Harris, editor-manager of the S.M.P.E., in which is presented the vista as viewed through the eyes of the latter organization.

The interest which is being manifest in the subject is an excellent sign that the industry is not disposed to remain dormant, to shirk its responsibilities, to hope for the best and yet do nothing to attain it.

Regarding the respective merit of either proposal as compared to the other, we reserve comment. The stimulating fact is that two great societies of the industry are bending their best efforts to the solution of a problem which has been a source of no inconsiderable annoyance since the advent of talking pictures.

Something must and will be done. We can depend upon these organizations to see the matter through. In the meantime, the projectionist himself can be of considerable assistance in bringing about a satisfactory solution to the problem. We are interested in hearing what our readers think on the subject. Any comments received will be published and thus passed on to both of the societies.

¶ *Cooperation*

WHEN it comes to a discussion of projection affairs there is no one whose opinion we respect more than that of Mr. P. A. McGuire, of the International Projector Corporation. The great outstanding characteristic of the man is that no matter how theoretical and scientific the discussion, he always keeps his feet firmly on the ground.

In the discussion following the report of the Projection Practice Committee of the S.M.P.E., which appears in our pages this month, Mr. McGuire leads the debate with a number of suggestions of prime importance anent the subject of cooperation among the various branches of the motion picture industry.

As Mr. McGuire so ably points out, there exists back of the artistic side of the industry a vast technical field whose work offers infinite opportunity for flaws and failures. What the public pays for is not the product of a single commercial organization, but is the result of the contributions from workers in many technical fields. Their interdependence renders imperative the need for coordination and cooperation.

The subject of film mutilation alone may be cited as affording an excellent opportunity for constructive work. We all are willing to concede that the evil exists. Every year it represents a tremendous loss in time and money. What are its causes? It is all very well to lay the blame at the door of the projectionist—that in the past has been the line of least resistance—but the projectionist, and very justly, has refused to take up the burden.

Now it is proposed to make an intelligent survey of the situation, an investigation unbiased and unprejudiced by any preconceived notions as to what the cause of film mutilation may be. The idea is an excellent one. In the final analysis the findings may be surprising to everyone concerned. The proposal should be particularly welcome to the earnest worker in the projection room. It may well mean the vindication of the craft.

CHARLES E. BROWNELL.

The Anastigmat Lens in Picture Projection

By ALAN A. COOK

Since its introduction a little over a year ago, the anastigmat lens as adapted to motion picture projection has attracted wide-spread attention. In the ensuing article the author explains the reasons for the development of this type of lens and why the exigencies of present-day projection particularly require its use. Mr. Cook is a member of the Scientific Bureau of the Bausch & Lomb Optical Co. The anastigmat lens as adapted for motion picture use is a product of that organization.—THE EDITOR.

IN the early days of the motion picture projector the first manufacturers naturally made use of the optical equipment that they found available at the time. The projection lens most suitable for the purpose was Petzval's Portrait Lens, announced in 1840, and modified scores of times by as many different lens designers. The general plan of this lens is shown in Fig. 1.

It is of no interest here to record the details of this construction and in fact impossible, for probably every manufacturer uses formulas peculiar to himself, none of which is exactly like the original Petzval lens. Within a few years after its invention, Petzval's original design was subjected to modification by Dallmeyer, Voightlander, and Zincke-Sommer. These modifications have become classic lens forms, but there have been plenty of other modifications which have never been honored by special mention.

Lens Requirements Analyzed

It is a remarkable fact that this form of projection lens should have maintained its leadership for such a long period of time, a period in which no kind of lens or optical instrument failed to receive thorough investigation at the hands of experienced and ingenious designers. The reason for this is apparent when the requirements of the objective lens are analyzed.

Motion picture projection in the average theater is a problem of projecting a picture which is small relative to the focal length of the lens but which must be magnified to an enormous degree. Yet the definition must be sharp and the illumination as brilliant as possible. In respect to magnification of the image the projection lens is subject to much more severe strain than the ordinary photographic lens. Consider the case in which we are projecting from standard film with a 4½-inch lens and a 120-foot throw, leading to a screen picture approximately 24 feet wide.

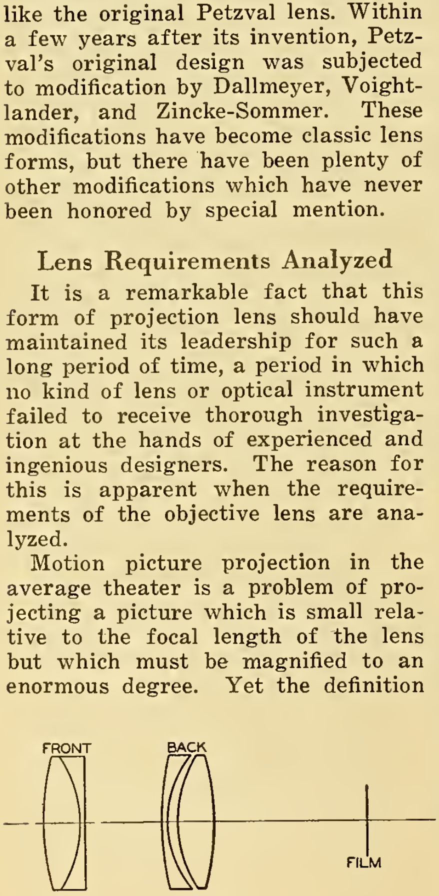


Fig. 1

Viewed from the position of the projector the screen image would subtend exactly the same angle as the film would appear to subtend to an eye located 4½ inches from it. Compared to the size of the picture as viewed from the projector, at 60 feet from the screen it would appear twice as large, at 20 feet six times as large. In other words, the picture would look six times as large at 20 feet from the screen as would the film held 4½ inches from the eye.

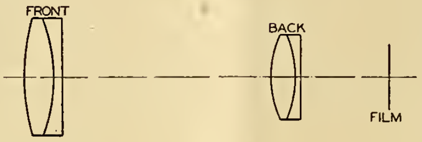


Fig. 2

Fine Definition a Necessity

A photograph, on the other hand, taken with a 4½-inch lens would probably be viewed at a distance of about 12 inches so that, in comparison to the test to which a photographic lens is put, the projection lens in this hypothetical case is subjected to a strain no less than fifteen times as severe. It is evident, therefore, that a lens must have the finest possible definition if it is to project motion pictures successfully.

On the other hand, the field of view which must be covered is much smaller than in ordinary photography. The long side of the film aperture subtends an angle of about 16 degrees for a projection lens of 4½-inch focal length, while a photographic objective of universal anastigmat type may be called upon to cover a field three times as great.

In addition, however, to this requirement of extraordinarily fine definition there is the further requirement of high illuminating power. This property is gained in a lens by making its aperture, that is, its useful diameter, large in comparison to the focal length, a practice which usually leads to a deterioration of definition because of the defect known as spherical zones.

This failure of a lens will be described in more detail in a later part of the paper together with other lens aberrations. It is sufficient to say here that it becomes more troublesome as the aperture of the lens is increased. The two requirements of a lens for motion picture projection are thus seen to be mutually antagonistic. They were met, however, to a satisfactory degree by the Petzval type of objectives which is characterized by its excellent definition over a small area even when the aperture of the lens is nearly half of the focal length.

Modification of the Petzval Type

Within the last ten years there has appeared on the market another type of projection lens that seems at first sight to differ considerably from the Petzval model. It is shown in Fig. 2. Inspection of the two forms shows, however, only two changes from the Petzval objective of Fig. 1. The separation between the front and back elements has been much increased and the rear pair of lenses has been cemented together. The increase in separation results in an extremely short distance between the rear lens and the focal plane, so that this type of objective has been often called a lens of short back focus. Its characteristics are not appreciably different from the Petzval objective, as will be shown later.

In recent years the requirements have changed somewhat, due to an increasing number of large theatres in which the size of the screen image has been considerably extended. This demand for higher magnification made necessary the use of shorter focal lengths, thereby increasing the angular field of the projection lens. Now the Petzval construction and its modifications had never shown excellent definition at the margin of the field. The defect had not been noticeable because the action is generally confined to the central part of the picture area, but with the use of short focal lengths to produce large screen pictures the lack of marginal sharpness became apparent.

Shortcomings of Petzval Lens

In optical terms this condition is expressed by saying that the Petzval lens cannot be simultaneously correct-

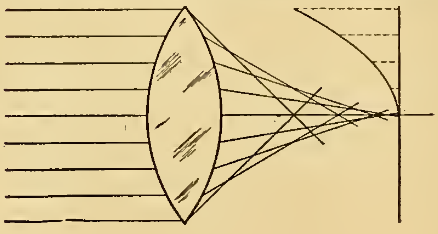


Fig. 3

ed for astigmatism and curvature of field. It will be well to give a brief definition of these expressions and others we may need to use. An ideal optical system for projection would image each point of the film area as a single point on the screen surface, and would reproduce exactly in the screen image the angles between all points and lines on the film. Such a projection might be constructed by drawing a line from every point of the film surface through a pinhole to represent the lens center, and continuing each line until it intersects the plane of the screen.

This pinhole imagery is an ideal that can never be reached in practice because an aperture of considerable size is always needed in order to allow a useful quantity of light to be transmitted. Finite size of aperture adds another condition, namely that all the light rays reaching the lens opening from any object point on the film must be reunited to the corresponding image point on the screen. These are the ideal conditions to be fulfilled.

No actual lens can meet them completely, but they are useful in that any lens can be judged by how far it fails to meet them. Single lenses fail rather completely and it has been found convenient to classify their defects and give them special names. These so-called aberrations of a lens are definite properties of the curved boundary surfaces. A few of them will be briefly defined.

Spherical and Chromatic Aberration

Let us limit ourselves for the moment to points on the optical axis,—the lens center line—and follow the peculiar way in which a simple lens forms an image of a distant object point. As shown in Fig. 3, each zone of the glass from center to lens rim forms an image of its own. These zonal images are not located at a focus or point on the axis, but are spaced at different distances from the lens. This is called spherical aberration and its effect will be a blur of light at the focus instead of a single sharply defined image point.

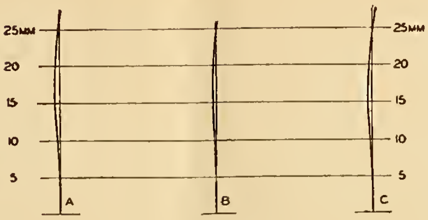


Fig. 4

It can be corrected by balancing against a similar aberration in a negative lens and should be eliminated as completely as possible in any outfit intended for projection use. The curve drawn in the upper right corner of Fig. 4 indicates by its departure from the straight vertical line the amount of spherical aberration that remains uncorrected. It is never possible in systems of large aperture to bring all the light entering an objective to one mathematical image point. There is always a small zone not perfectly corrected, but this spherical zone need not be so large as to be perceptible as grayness in the screen image.

The correction for light of different colors should be mentioned here as another requirement for sharpness at an axial image point. It is a familiar fact that single lenses give a series of separate colored images instead of a single white one when the object is illuminated with white light. The lens acts like a prism in this respect and analyzes the light into its separate components. This is chromatic aberration.

It must be corrected by using more than one element in a lens and proportioning them so that the color effects of the elements neutralize each other at the image point. No one design can be said to be superior here; all must be well corrected to stand the strain of the enormous magnification at which motion pictures are projected.

In Fig. 4 are three curves representing the spherical correction of some typical projection lenses. These were drawn from the actual values measured on lenses of equal focal length and equal aperture and are thus an index of the defining power of the three types at points near the center of the screen. B is a good sample of the Petzval objective, C is a lens of the short back focus type, and A is a modern anastigmat. The similarity of the curves shows clearly that all of these objectives are equally well corrected in respect to central definition. The differences between anastigmats and ordinary lenses is not apparent until we get to the outer parts of the film, to points outside the axial region.

Astigmatism and Its Effect

To analyze this situation further another aberration known as astigmatism must be considered. It is illustrated in Fig. 5, which shows how an uncorrected lens forms an image at 0′ of a point 0 at the margin of the field. In this case the imagery is much poorer than for an axial point, the nearest thing to an image that we get being an elliptical spot of light.

The cone of light simply does not come to a point focus anywhere in the vicinity of 0′; at t′ in the diagram it contracts into a short line at one place, and farther on at s′ it again forms a line at right angles to the t′ line. Then it broadens out into an oval spot at the image plane. t′ is the focus for rays that pass through the vertical meridian (t) of the lens and s′ is the focus of the horizontal plane (s). This faulty image quality in which a point of the object is represented by two separated perpendicular lines somewhere near the correct image point is called astigmatism. In an uncorrected lens it warps the image surface into a curve which cannot be made to coincide with the flat plane of the screen. This is due to the fact that the best focus for 0′ is found at a place half way between t′ and s′; the distance between 0′ and this halfway point is the curvature of field for this particu-

(*Continued on page* 19)

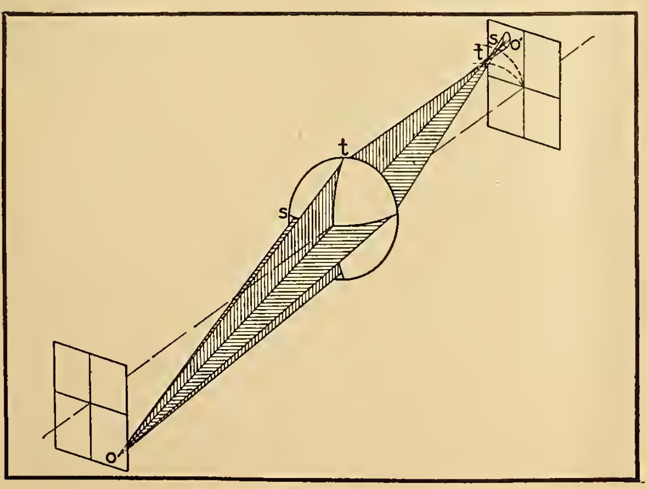


Fig. 5

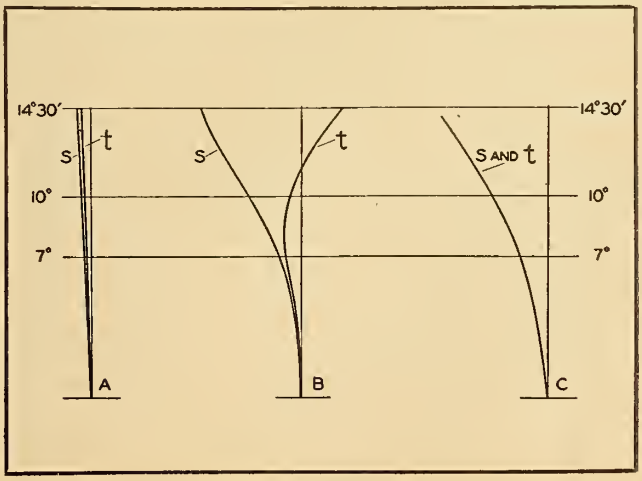


Fig. 6

Painting the Silver Sheet

By JOHN L. CASS

Part III. Color Reproduction Methods

Color has been referred to by Mr. John I. Crabtree, retired president of the S.M.P.E., as the only immediately available variant from the prevailing black and white picture, and its further development is anticipated by leaders of the Industry as the next outstanding technical achievement. The following article from the pen of Mr. John L. Cass, assistant chief engineer of RCA Photophone, marks the third of a series to be contributed by the author on this important subject. Mr. Cass is particularly qualified to discuss the application of color in motion picture science, his engineering experience having embraced many years of research in the color picture field.—THE EDITOR.

IN a preceding article of this series the problems involved in obtaining color separation negatives were discussed at some length. The difficulties encountered in color cinematography were found to be largely optical and mechanical, with constant effort toward minimizing the disruption of black and white production technic.

In producing prints from the color separation negatives, there is a reverse relationship, in that there are no limitations on the process used other than to produce prints which will project in the standard black and white manner. This is very fortunate, due to the difficulty and complexity of producing images in color which will represent the original scene with some degree of accuracy. The methods in use in existing color print laboratories have very little similarity to each other or to black and white laboratories.

Due to general considerations stated in an earlier article, this paper will be limited to a discussion of two color subtractive processes. In simple terms, a subtractive print is one which appears the same on the film as its projected image on the screen, assuming that the film is inspected by transmitted light. In the additive systems, the individual images do not appear as naturally blended, since the blending takes place on the screen. The terms "additive" and "subtractive" are derived from the two general methods of producing color on a screen by means of projected light.

In the additive type, the color components are projected separately, either simultaneously or in rapid succession, and are mixed on the screen, either concurrently or through the phenomenon of persistence of vision. Since the components are "added", the method is additive. In subtractive methods, a single beam of white light is passed through filtering media which remove those colors not desired, so that the beam striking the screen is composed of those colors which have not been subtracted.

Filters and Color Reversal

In the production of subtractive two color prints, there is one point which is puzzling to most persons when it first comes to their attention. This apparent peculiarity is the reversal of color which takes place after printing. The positive image which is printed from the red filter negative must be dyed green, and vice versa. Reference to Fig. 2 will indicate why this reversal is necessary.

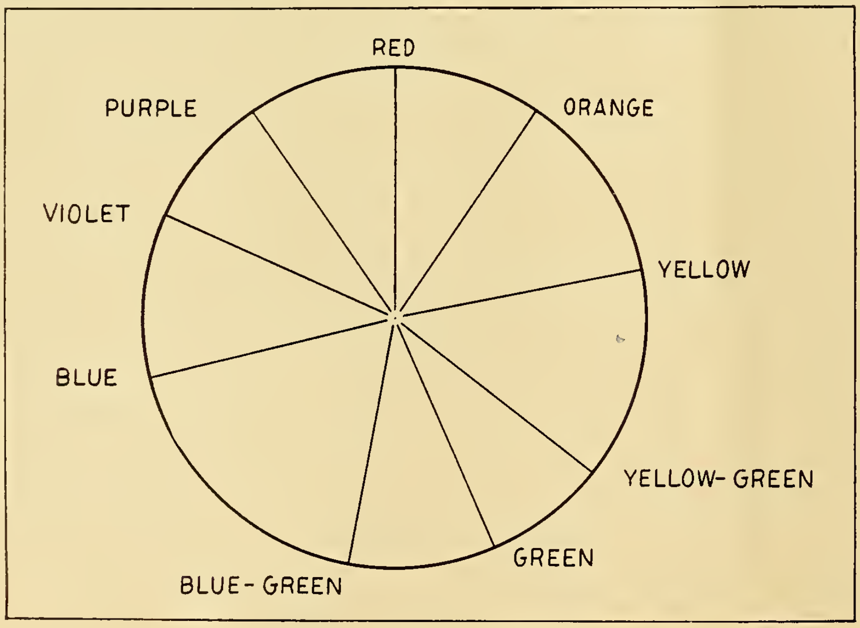


Fig. 1. The Color Circle

Assuming that the colors indicated are pure and saturated, the green area will not register through the red filter, and will produce no negative density. On the other hand, since white is composed of both red and green, the red portion of the white light will expose this negative fully, as also will the red area. Thus the negative made through the red filter will appear as shown.

When this negative is used for printing, the positive image resulting will be reversed in density as shown, leaving a black square against a clear background. Since this black square represents a green square in the original subject, it must be converted to green. A similar situation exists in the other color separation. When dyed as shown, and superimposed, the positive print will be correct upon projection.

Methods of Production

In general, existing methods of producing two color subtractive prints consist of some printing method and some developing method, with additional steps which convert the developed silver images to color. Special printing machines are used, varying in form in various processes due to differences in either the form of the negatives or in the stock upon which the positive images are to be produced.

The simplest form in which two-color prints are produced is that in which raw positive is used which is coated on both sides rather than on the conventional single side. The emulsion used is similar to that on black and white positive, with a small amount of yellow dye included to prevent printing through. This type of raw stock may be utilized in two general ways, known as (1) "Chemical toning" and (2) "Dye toning." In either case, the color separation negatives are utilized for printing on opposite sides of the double coated stock.

The two negative images which were exposed simultaneously in the camera are printed opposite each other, the actual printing operation being either simultaneous or sequential. Printing is by contact in most cases, and particular care must be taken that the two images coincide in position, since an error in registration of one-thousandth of an inch will appear on a theater screen as fringes of color approximately one-half of an inch wide.

A secondary, but equally serious, effect of lack of registration is in loss of sharpness in screen image, due to the loss of line. It is of interest to note that a well photographed color picture, with registration approaching perfection, produces a distinct illusion of depth, or third dimension, due to the natural effect of proper color composition. This depth effect is not to be confused with binocular vision, but is probably similar to the effect of atmospheric haze, called "distant purple" and other similar descriptive names.

Toning the Positive

After printing, the positive is developed and fixed along conventional lines, except that both sides of the film are exposed to the action of the solutions. This development results in metallic silver images, as in black and white. These images are then converted by some method to color images which, in combination, will constitute a two-color subtractive print.

When *chemical toning* is used as the conversion method, the metallic silver is chemically converted to metallic compounds which have the desired colors as inherent characteristics. Salts of iron, uranium, and other metals are used for producing the necessary orange-red and blue-green images. Since the colors produced by this method are dependent upon the natural color of the chemical compounds produced, it follows that the choice of color is limited to the producible compounds.

Unfortunately the colors which may be produced in this way do not correspond accurately to the orange-red and blue-green combination which has been found to be most suitable. The result has been that color rendition by straight chemical toning has not been accurate as to complementary characteristic, and has not been particularly pleasing in actual color combinations. As a result, various methods of dyeing have been resorted to in order to improve color rendering.

Dye Toning

In its simplest form, *dye toning* is used merely to correct the basic images obtained through chemical toning. The result is then a combination of the two. Other methods have been used extensively in which the visible images are composed entirely of dyes. Where double coated raw stock is used, this type of process usually is of the dye mordanting type.

Several processes have been devised in which the silver images after development have been converted into chemical compounds which in themselves are practically invisible, but which serve to fix dyes with which they come in contact. Iodine is one of the elements utilized in this manner, and is best exemplified in the Brewster process.

The actual chemical compounds which are formed in mordanting processes are quite complex, but all act in about the same way. The film is prepared for dyeing in a preliminary chemical bath which changes the metallic silver of the images into the particular mordanting compound being used. That side of the film which is to carry the red image is then brought into contact with a solution of red dye having the proper color characteristic and which may be mordanted by that particular chemical. The entire coating absorbs dye, the clear gelatine portions as well as the image portions.

After the dye immersion, the clear gelatine portions are washed out by some method, either chemical or plain water, but the dye which has come in contact with the mordanting chemical is held in position. The result is a red image which is graduated in intensity in a direct relationship with the original subject. A similar sequence of operations produces a similar green image on the opposite side.

There are many variations in the actual methods used, but all dye toning methods share in the advantage that more flexibility is provided than in the case of chemical toning. Solutions of blended dyes may be used in order to approximate the ideal condition for two color rendering.

Technicolor Methods

There have been two methods used by Technicolor, both of which are of interest because of their commercial significance. The earlier method resulted in a double coated print, but did not start off with double coated positive raw stock as described above. In the case of early Technicolor, the positive images were printed on two separate strips of raw stock, the red separations on one strip, the green separations on the other. The emulsion contained a relatively high percentage of yellow dye, which served to concentrate the images toward the surface of the coating.

Printing was done through the supporting base so that the concentrated images were against the celluloid rather than on the outer surfaces. After printing, the twin positives were cemented together, celluloid to celluloid, forming a double coated film. The developing process was of such a nature that the gelatine in the image regions was hardened physically, after which the silver image was completely removed, leaving the coating as composed of hardened and unhardened gelatine. Since the hardened gelatine was against the celluloid base, the softer gelatine could then be washed off, or "etched," in a hot water bath of the proper temperature.

The images at this point in the process were present as gelatine reliefs, representing in thickness the desired intensity of color. A simple immersion in the proper dye baths completed the images, followed by a protective varnish coat. The resulting print was of the two color subtractive variety.

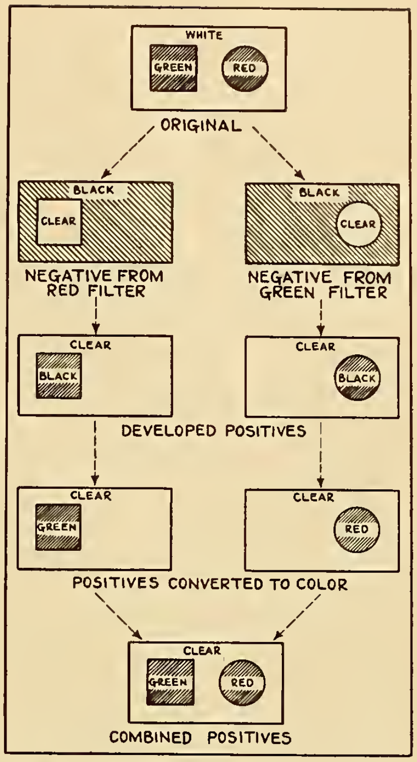


Fig. 2. Graphic Illustration of Process

Imbibition Process

For various practical reasons, Technicolor changed over to a radically different type of print, made by the "Imbibition" process. In this method, much of the technic of the earlier Technicolor method was adapted to produce the intermediate medium in imbibition, the "matrix." The process of printing and developing the matrix is essentially the same as before, but the two strips do not become cemented together. They remain separate, and are designated respectively as "red matrix" and "green matrix."

The raw stock which becomes the actual print is called "blank" because it is a clear gelatine coating on the conventional celluloid base. This gelatine coating is carefully prepared as to hardness and other characteristics. The actual production of images on the blank is accomplished in much the same manner as the blotting of wet ink, in which a reversed image is left on the blotter.

The print is produced on a "transfer" machine, in which a number of operations take place. One of the matrices, say the red matrix, is passed through a bath of red dye, in which the gelatine relief images take up dye to saturation. After the excess of dye has been removed, the red matrix is brought into intimate contact with the blank, whereupon a portion of the dye transfers into the gelatine of the blank. The red matrix is then removed from the blank, is cleansed of dye, and is saved for further use.

The process is repeated with the green matrix, so that the green images are transferred into the same gelatine which already contains the red images, thus producing a two-color subtractive print. The matrices are used a great number of times, thus reducing the necessity of long continued printing from the original negative.

The imbibition process as herein described appears to be a comparatively simple color method. Actually it represents many years of intensive research on the part of many patient workers. The obvious advantages of imbibition are the physical character of the final print, which is more hardy than black and white, and the lowered cost of production over earlier methods. The most obvious disadvantage is the tendency toward lack of sharpness in the final images, but this is held at a minimum through a highly developed system of process control. Great credit is due the Technicolor technicians for the pioneering work they have accomplished in making imbibition a practical method for the production of prints.

(*To be continued*)

Progress and the Projectionist

By D. C. McGALLIARD†

THE responsibilities of the projectionist in the modern sound-equipped theatre are now twofold; projection of picture and projection of sound. Each fails badly unless adequately supplemented by the other. The projectionist has consequently been faced with the necessity for rapidly broadening his knowledge to include the new field of sound, if he is to keep pace with the added responsibilities. He had thrust upon him almost overnight an entirely new subject in which few had had experience. Little was available in the way of printed information for his guidance. Although he was usually given instructions in its operation at the time the equipment was installed, most of his training was necessarily obtained in the school of experience.

Responsibilities Realized

That projectionists as a group have realized the responsibilities and opportunities presented by this new field is apparent from the consistently high quality of the results they have obtained in the face of severe handicaps. Their training, study and attention to meet the introduction of sound have undoubtedly been reflected in better operation of the picture projection equipment itself. Machines must be operated more quietly and efficiently, cues must be watched more closely, definite routines are more necessary and, in general, the demands on the projectionist's skill are greater. Consequently, while no definite figures are available, it is fairly safe to assume that the average number of interruptions to the show are fewer now, even with sound, than in the days of silent pictures.

Let us briefly analyze those factors over which the projectionist has definite control and which go far towards producing perfect projection of picture and sound. From the picture projection standpoint these factors are clear, steady projection, clean prints, good changeovers and careful operation. From the sound projection standpoint we have, first of all, the necessity for equipment which is electrically and mechanically well designed and well built, consequently capable of reproducing the sound record with uniformly good quality and sufficient volume.

The best of equipment cannot, however, give good results unless it is carefully operated and well maintained. Careful operation includes such items as cleanliness, correct volume control, fader manipulation, smooth sound changeovers and rehearsals. Efficient maintenance will include routine testing before shows, daily checking of batteries, generating or rectifier equipment, careful lubrication and frequent mechanical and electrical inspection of the sound unit and associated equipment.

The field of sound is extremely broad in scope, the surface has as yet scarcely been scratched. No one man or group of men can know all there is to be known about sound. The knowledge we have today is likely to be quite out of date tomorrow as we gain further experience and revise our ideas.

Progress of the Art

We have witnessed a remarkable progress in the art of sound reproduction in the few years since the introduction of the talking picture. What does the future hold for us and in what direction should we look for developments? Primarily, broader frequency response ranges and greater volume ranges, which means even better recording and reproducing equipment must be developed. Better and more uniform quality of release prints, standardization of apertures and sound tracks, acoustic studies and treatment of recording studios and theatres, color, wide screen projection—all these are within sight. As they are developed it is the wide-awake projectionist who will be able to reap the full benefits from them.

There is much food for thought in the old adage that "we grow while we are green." The man who is content to rest on his laurels, who feels that his ability has reached its peak, that there is not much left for him to learn, is backsliding badly and on the road to unemployment. He may continue to hold his job for a little while, but eventually will be replaced by the man whose eyes and ears are open and whose mind is receptive to new ideas.

Fortunately, there are numerous reliable sources of information available to the projectionist. These sources include textbooks, professional society meetings, the local Service Engineer and trade magazines. Textbooks are very helpful, but must be frequently revised if they are to be kept accurate in such a rapidly changing field as our own. Professional meetings, if well planned and provided with authoritative speakers, offer an excellent opportunity to meet others in the industry, to get first-hand information, and to clear up by questions any points which are puzzling. Service Engineers are glad to discuss with projectionists the problems relating to sound projection.

It is to the trade magazines, however, that the projectionist must look for the most up-to-the-minute information on current events of interest to him. A live-wire magazine issued at frequent intervals and having an editorial staff with its finger on the pulse of the industry will furnish much valuable information to the projectionist who will take the time to read carefully and digest it.

---

† Instruction Manager, Operating Dept. Electrical Research Products, Inc.

Fish-Schurman Moves

The advent of the new year marked the removal of the Fish-Schurman Corporation from their old address to 230 East 45th Street, New York City, where the executive offices and warehouse of the company are now located in much larger and more spacious quarters.

The Fish-Schurman Corporation is the sole agent for distribution in this country of S. O. G. "Ignal" condenser lenses, which since their introduction on the domestic market have achieved unprecedented success. These lenses are manufactured according to precise standards from "Ignal" glass, which is a pure, white, optical glass. It is produced annealed to enable it to withstand extreme changes of temperature without danger of cracking.

The "Ignal" condenser was perfected by the S. O. G. Optical Glass Works of Berlin, and its American sales agents claim that until the time of its appearance it was extremely difficult if not well-nigh impossible to produce a lens combining heat resistance with superior optical qualities. The brilliancy of the glass, it is said, is not affected under the most arduous service.

This Question of Picture Apertures

By SYLVAN HARRIS

Editor-Manager of the Society of Motion Picture Engineers

In the following article, which is published exclusively in THE MOTION PICTURE PROJECTIONIST, *Mr. Harris presents some interesting facts concerning the activities and views of the Society of Motion Picture Engineers regarding the establishment of standard dimensions for camera and projector apertures. It is indeed gratifying to observe the attention which is being manifest on the part of the Society toward this important question, and it is certainly to be expected that its efforts will contribute much to the final and successful solution of the problem.*—THE EDITOR.

THE importance of the Society of Motion Picture Engineers as a stabilizing and impartial agency in directing the progress of motion picture technology was well attested recently by the vigor with which the Society attacked the problem of standardizing the dimensions of projector apertures. As it would be difficult for one properly to evaluate prevailing conditions from a knowledge of only his local or restricted conditions, so it would be difficult for any organization devoting its attention mainly to one phase of the art, to arrive at conclusions acceptable to and conformable with all phases.

The Society of Motion Picture Engineers is fortunate in these respects: in that it contains within its rank eminent representatives of all phases of motion picture technology; and that the collaboration of all these representatives, and the coordinating of the viewpoints peculiar to all these phases, leads to solutions of the problems, or compromises when necessary, which, if not entirely satisfactory from all points of view, react in the end to the advantage of the art at large.

S.M.P.E. Considers Problem

The solution of the problem of specifying dimensions of projector apertures was recently undertaken by the Projection Practice Committee of the Society of Motion Picture Engineers for the purpose of agreeing upon a set of dimensions which could be presented to the Standards Committee of the Society for validation and approval.

The aperture used in projectors prior to the addition of sound to the motion picture measured 0.680 x 0.906 inch. These dimensions provided a projected picture on the screen which had a height-to-width ratio of 3 x 4, for a projection angle of zero degrees.

On the addition of sound to the picture, and to avoid projecting the sound to the screen, the dimensions of the projector aperture were changed to 0.680 x 0.800 inch. This reduction of the width made it necessary to mask the picture at the top and bottom to prevent the shape from becoming square when using a projection angle of zero degrees. In many theatres the inclination of the projection angle resulted in a picture shape that was actually square; and, in some theatres having large projection angles, the height actually exceeded the width. It is generally agreed by producers and exhibitors that these are undesirable shapes for the picture.

The Remedy Adopted

On account of these difficulties, the practice was introduced in the theatres of adjusting the apertures to 0.600 x 0.800 inch, providing a 3 x 4 shape picture when using a projection angle of zero degrees. However, the pictures were still photographed with cameras having ground glass markings equivalent to an aperture of 0.620 x 0.835 inch, corresponding to the projector aperture of 0.680 x 0.800 inch mentioned previously. This arrangement provided a more suitable condition for the theatres as regards the shape of the picture, and although the 3 x 4 ratio was obtained only when using a projection angle of zero degrees, the picture did not become higher than it was wide in theatres which had large projection angles. However, by reducing the height of the aperture from 0.680 to 0.600 inch, the tops and the bottoms of the pictures were not projected to the screens.

Quoting from the material published by the Academy of Motion Picture Arts and Sciences: "As a temporary measure, the Academy recommended that all vital action be kept within a 3 x 4 rectangle marked on the camera glass, of such size that the picture would not suffer when projected through a reduced proportional aperture. For the past year cameramen have thus had to fill about 20 per cent of the film—the 10 per cent of sound track area, 5 per cent at the top and 5 per cent at the bottom—with nonvital action or incidental views of the set.

"The proposal now is to mat off this useless space in the camera and standardize on the 3 x 4 picture proportions preferred by the theatres. By careful calculations it has been found possible to use a little more image area on the film than has been included inside the marks on the ground glass and thus give 4 per cent more image area for vital photographic action to reach the screen."

Accordingly, the projector aperture recommended by the Academy had the dimensions 0.615 x 0.825 inch, which provided a picture in the ratio of 3 x 4 when projecting at an angle of zero degrees. This corresponds to a camera aperture of 0.651 x 0.868 inch.

S.M.P.E. Recommendations

After various conferences recently called for the purpose of considering these proposed specifications, it developed that so long as a change of projector aperture is necessary, this change should be made in the correct direction as regards requirements for good projection in the Class A theatres; that instead of *increasing* the height of the aperture, it is more desirable to *decrease* it in order to obtain desirable shapes of pictures when large projection angles are used. It was felt also that the 0.615 x 0.825 recommendation was too liberal in allowances. A compromise suggestion, which, however, was not formally placed before the Society of Motion Picture Engineers was finally reached, assigning to the projector aperture the dimensions 0.600 x 0.825 inch, thus providing a 3 x 4 picture at a projection angle of 14 degrees.

Conformably to the ideas expressed previously, the Projection Practice Committee of the Society of Motion Picture Engineers recently adopted for recommendation to the Standards and Nomenclature Committee of the S.M.P.E. for its approval and validation, the dimensions 0.590 x 0.825 for the projector aperture.

How Determined

This value of the height was arrived at after consideration of the projection angles used in the Class A theatres throughout the country, and was determined on the basis of providing a 3 x 4 picture projected at an angle of 18 degrees, the latter figure being chosen as a practical arbitrary reference angle. It was felt that such a proportion would provide shapes of pictures which would be acceptable in the Class A theatres which use projection angles as great as 24 degrees, and, at the same time, would provide pleasing shapes of pictures in houses using small projection angles.

The change of shape of the projected pictures becomes less as the angle of projection decreases, and the decrease in the ratio of the height to the width would, after all, provide a more pleasing picture shape for the theatres employing the smaller projection angles.

It happens, therefore, that there are

three propositions at present being considered:

1. The original Academy proposal
   Projector: 0.615 x 0.825 3 x 4 at 0°
   Camera: 0.651 x 0.868
2. Compromise proposal. (Not formally presented to the S.M.P.E.)
   Projector: 0.600 x 0.825 3 x 4 at 14°
   Camera: 0.623 x 0.868
3. S.M.P.E. Projection Practice Committee proposal.
   Projector: 0.590 x 0.825 3 x 4 at 18°
   Camera: 0.625 x 0.868

It is the function of the Standards Committee of the Society of Motion Picture Engineers to accept, reject, or to modify any recommendations that may be made to it; where a difference of opinion subsists between this body and any other with regard to recommended specifications, it is the function of the Standards Committee to accept or reject the recommendations in their entirety, or to propose alterations of the recommended specifications. Otherwise stated, the formulation of standards having the approval of the S.M.P.E. is entrusted to this committee. (Subject to final review by the Board of Governors.)

As a corollary to this, it is also the function of the standardizing body to study carefully all the facts upon which the choice of specifications may be based, or upon which any controversy may be grounded.

Shrinkage and Weave

Among the problems to be considered in relation to the specification of aperture dimensions is that of providing sufficient allowance for shrinkage and for weaving of the film in the projector; the camera aperture must be about 5 per cent greater in both dimensions than the projector aperture. This would make the dimensions of the camera aperture corresponding to a projector aperture of 0.600 x 0.825 approximately 0.623 x 0.868 inch.

The difference of twenty-three mills provided between the 0.600 dimension and the 0.623 dimension aids in framing the picture. The main requisite is to keep the action which is being photographed within the 0.590 dimension, whereas the unofficial requirement, demanding 0.600 inch for that purpose, would make it necessary to increase the projector aperture in order to encompass the entire action.

Projection Angle and Seating

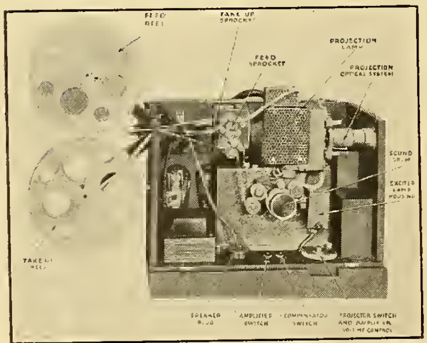
In analyzing this matter, the question arises as to whether the larger and more important theatres, having large projection angles, are to be penalized in this respect; and it was further pointed out that in arriving at the dimensions of the standard aperture, thought should be given to the arrangement of the seats in the theatre under consideration so that a complete view of the screen may be obtained from every seat in the house and that such view may not disclose the several types of distortion which may arise from an injudicious choice of aperture dimensions.

It is a moot question, also, whether the standardization of aperture dimensions should be determined by the invariable conditions which exist in the laboratories rather than by the highly variable conditions existing in the theatres; from one point of view it appears that the problem is not necessarily that of grounding the conclusions on invariable conditions, but rather that of adapting whatever conclusions may be reached to the actual practical conditions existing in the theatres, and which, in the final analysis, exert their influence upon the box-office receipts, by virtue of which not only the theatres, but the studios as well, exist.

16mm. Sound-on-Film Equipment

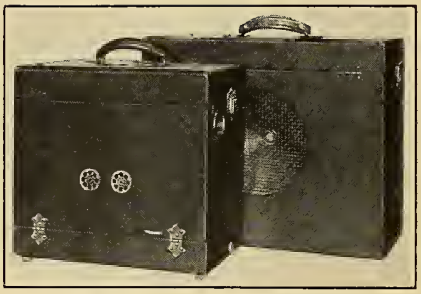
RCA Photophone's Latest Accomplishment

ANNOUNCED as the culmination of four years of intensive development and heralded as the most advanced step in the field of sound reproduction since the motion picture screen became articulate, RCA Photophone, Inc., and the RCA Victor Company, at a preview and demonstration before an invited audience in its private theatre, No. 411 Fifth avenue, January 21st introduced a new all AC operated 16 mm. sound-on-film motion picture projector.



Projector With Case Open

Manufactured by the RCA Victor Company at its plant in Camden, N. J., and referred to as the RCA Photophone Junior Portable to distinguish it from the 35 mm. Senior Portable which has been on the market for more than a year, the new machine gave rather an amazing performance when its own dimensions and the dimensions of the slender thread of film used are taken into consideration. With the projector placed about thirty feet distant from the screen and the loudspeaker behind the screen, a picture about 4 feet by 6 feet in dimensions and sound of excellent quality were reproduced with remarkable fidelity. Industrial leaders, educators, ministers and others who previously had been privileged to witness the demonstration of the new apparatus are said to have been enthused over its possibilities in their respective fields of endeavor.



Projector and Loudspeaker

The equipment consists of a projector-amplifier unit and a small loudspeaker unit. The entire equipment is operated from any 110 volt, 50 or 60 cycle AC lighting circuit.

Details of Equipment

The projector-amplifier unit is 14½ inches long, 13¼ inches high, 8¼ inches wide and weighs 43 pounds. The equipment is not removed from its case during operation, the interior mechanism being readily accessible for such adjustments of the projector, replacement of radiotrons, lamps and photocells as may be required. During the actual presentation of sound pictures, the case is closed to reduce to a minimum extraneous noise caused by the operation of the projector mechanism.

The projector is equipped with an optical system which projects pictures varying in size from 22 inches wide to 16 inches high at a distance of from 10 feet; to 67 inches wide by 50 inches high at a distance of 30 feet. The picture size recommended for good illumination is 52 inches wide by 39 inches high. This size is obtained at a projection distance of 23 feet.

The exciter lamp is a 4 volt, .75 ampere Mazda lamp and the radiotrons used in the amplifier are one UX-868 photocell, one UY-224, one UY-227, three UX-345s, and one UX-280. All power for the operation of the loudspeaker is obtained from the projection-amplifier unit.

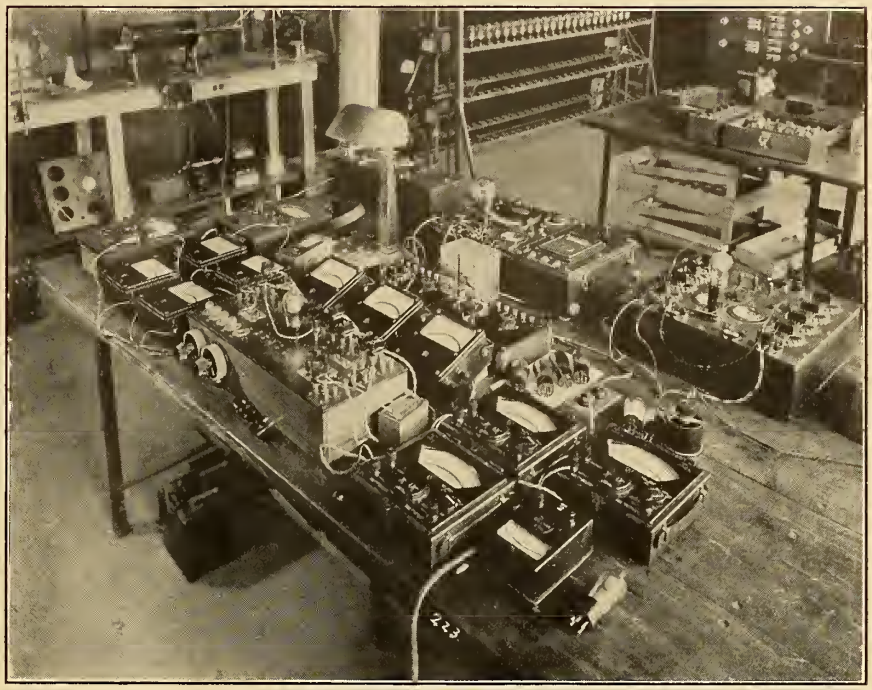
The loudspeaker is mounted in an individual carrying case which is 19 inches long, 16 inches high, 9½ inches wide and weighing 21 pounds exclusive of film cases, film reels and film. Space is provided in the case for the storage of eight film cans for 400-foot film reels. This loudspeaker is of the flat baffle type with the dynamic speaker unit mounted behind the screened opening in the front of

(*Continued on page 22*)

Tubes and Their Troubles

By E. R. WAGNER, PH.D.

While the vacuum tube no longer presents the mystery that it once held for the projectionist, there are, nevertheless, many properties of this vital factor in the sound-reproducing system which, if clearly explained, will enable the user to operate the tube to its and his best advantage. In the discussion which follows Dr. Wagner, who is a member of the Engineering Staff of the Duovac Radio Tube Corporation, considers some of the commoner troubles encountered in the use of vacuum tubes and offers some helpful suggestions for their avoidance and correction.—THE EDITOR.



Tube Testing Equipment

VACUUM tubes are not the delicate things they were even five years ago, and they will stand quite a lot of abuse before protesting. Like all other apparatus designed to perform a specific function, they operate most satisfactorily when used under conditions specified by the manufacturer. There are, however, many questions which arise regarding their proper use.

Why, for example, should the filament voltage be kept below a certain value? Why should the rheostat knob be turned until the pointer on the meter reaches the red mark? What will happen if it should go beyond the mark, and a greater current flow through the filament than that on which it is designed to operate? The answer is "trouble" and plenty of it.

Filament Construction

In the first place the filament in the smaller tube is made of nickel, or an alloy of nickel with silicon, cobalt, chromium or other base metal. These metals are very ductile at operating temperatures, and possess a much lower tensile strength than does a tungsten filament under similar conditions.

Since the filament hook exerts considerable tension, care is exercised in the factory to adjust the pull of the hook to the strength of the filament, and if the latter is heated above its normal operating temperatures, it may be stretched. This elongation is, of course, accompanied by a decrease in the cross-section of the filament. A high resistance path is formed. Hot spots result. These hot spots are the weakest places, and the pull of the hook can easily cause a complete break at these points. We call it a "burn out." It is actually a "pull out" and may have had its start in someone's carelessness.

The usual tendency is to raise the filament current in order that the plate current be increased. This may, or may not, result. It depends entirely on the design of the filament, and again it is safer to take the manufacturer's word for the proper operating conditions than to assume that your own knowledge is more profound than is his. A glance at the figures 1 and 2 will show why this is true.

Assuming a constant grid bias, or else that grid and plate are tied together, Fig. 1 indicates that plate current increase, with increase in plate voltage, reaches a maximum value at any given filament current, or filament temperature. Beyond the upper "knee" in any curve, no further plate current increase is obtained except with increased plate voltage, because at any given filament temperature only a certain number of electrons can flow between filament and plate.

As soon as the plate voltage becomes great enough to attract all of these electrons to the plate, further increase in this voltage can do nothing, and we have reached the flat part of our curve. It is therefore evident that there is a maximum useful plate voltage for any given filament current.

In Fig. 2 we see that at any given plate voltage increased plate current results from increased filament current only until the upper knee of the curve is reached. Here we encounter the condition that, while the filament emits more electrons at the higher temperature, the plate voltage limits the number that can be used. Increasing Ep will, at the higher temperature, increase Ip, as shown by the curve. If the physical characteristics of the filament would permit it, some of this increased output would be used. Not all of the increase may be used, however, because another factor comes in. This factor is the chemical nature of the active surface.

Filament Coating

The usual coating of a filament consists of a mixture of barium and strontium oxides. These oxides are not the actual emitters, but are the parent substances from which the active material is obtained. These oxides melt at temperatures that are higher than the melting point of the filament metal, but the active materials are metallic barium and strontium, both of which evaporate very readily at temperatures but slightly higher than the average operating temperature of a filament.

This active layer is, on an average, one molecule deep. In layers of this depth molecular attractions are greater than is the tendency to form vapor, and the active surface remains on the hot filament. Although slow evaporation does occur under operating conditions, the escaping molecules are replaced from the layer of oxides, probably by an electrolytic action. If, however, the temperature of the filament is unduly increased the loss by evaporation may exceed the rate

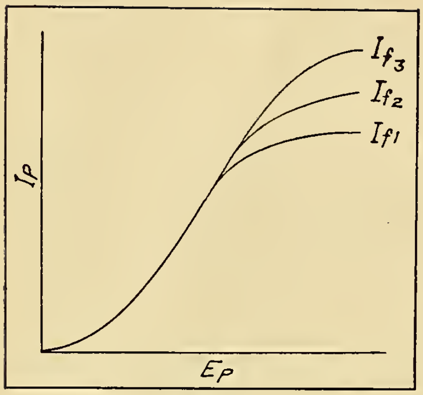


Fig. 1

of replacement, and we have a tube that shows "dropping emission." This condition is also found in some tubes where for some reason or other the filament has been damaged or improperly prepared.

Thoriated Tungsten Filaments

So far only oxide-coated filaments have been considered. In tubes such as the 201A, 199, 239, 811, 242 and 845, among others, a thoriated tungsten filament is the emitter. In such filaments the parent substance of the active surface is thorium oxide, held in suspension within the body of the tungsten wire. To bring it to the surface, the filament must be heated to a very high temperature—usually around 2000°C. During the operating of the tube the filament is kept at 1000° to 1200°C.

Oxide-coated filaments would be ruined in a very few minutes at the operating temperature of the thoriated filament, and thoriated filaments would be hopelessly inefficient at temperatures used for oxide-coated types. They must be treated differently. The same operating characteristics hold for both types, but the ailments of the two are somewhat different. An exhausted thoriated filament may be regenerated by greatly raising its temperature for a short time. This treatment permits some fresh thorium oxide to migrate to the surface, and thereby to replenish the emitter. No plate voltage is applied. This same treatment would ruin an oxide-coated type.

So much for the filament, its use and abuse.

Gas and Its Effects

The bogey man of the vacuum tube is undoubtedly spelled g-a-s. Gas, in its various manifestations, may cause an endless variety of troubles, many of which are difficult to identify because leakage and gas effects are usually lumped in the measurement of gas in a tube.

To begin: Gas, as such, is not harmful except when it is oxygen or an oxidizing agent. In this case it may attack the hot metal of the filament and form a high resistance coating of nickel oxide on the wire, or tungsten oxide, if the filament be tungsten.

The nickel oxide has a very high electrical resistance and "low emission" may result. The active surface is burned off in both oxide-coated and thoriated tungsten filaments by oxygen, and thus the emission is "killed." This is a purely chemical action of one variety of gas on the filament. Non-oxidizing gases such as hydrogen, nitrogen, or the rare gases, have no deleterious chemical effect on the filament. They do have other effects and these are very pronounced.

Ionization by Collision

When an electron collides with a gas molecule it may either just push it out of the way, which happens at least 999 times in every 1,000 collisions, or it may hit it hard enough to throw an electron out of the molecule—about once in a thousand impacts. If it has accomplished this feat, the gas particle is now electrically charged positively and we call it an ion.

It must now act as an electric charge, and is affected by potential differences. Under the influence of the plate voltage, it is attracted to the filament, and hits it with an energy equal to the product of the number of unit charges it carries and the potential through which it has fallen.

Dr. Whitney of the General Electric Company has shown that when the ion falls through a potential drop of more than 20 volts it will destroy the active surface of an oxide-coated cathode. Since none of the ordinary gases require much less than 20 volts to ionize, it follows that any gas when ionized may wreck a filament by bombardment. By permitting only a small amount of gas to be present the effect on the filament is harmless. It may even be beneficial in keeping the filament active. The permissible amount will vary with the tube.

These positive ions also do other things besides bombard the filament. Since they are positively charged and come between the filament and the plate, they act as a grid with a positive charge and thus interfere with the regular grid which is negative. This results in a greatly increased plate current through reduction of the effective grid bias and through partial neutralization of the space charge.

"Back Emission"

The electrons leaving the filament now encounter a smaller retarding force and are accelerated. The plate is bombarded by more and faster electrons. It gets hot and frequently itself becomes a good enough emitter to cause "back emission," or emission in a reverse direction. The tube loses its characteristics and distortion sets in.

In the case of a rectifier this back emission becomes a serious factor when it is pronounced, because it permits current to flow from plate to filament and thereby decreases the efficiency of the tube.

Gas-filled tubes, such as the 866 and 872, are not exceptions to the foregoing discussion of gas effects. Tubes using oxide-coated filaments may function in the presence of mercury vapor, because the mercury molecules are ionized at 10.4 volts and the tubes are so designed that the total potential drop in the tube is less than 20 volts. The filament is thereby unaffected. When, in a mercury vapor tube, the voltage drop exceeds 20 volts, the life of the filament is very much shortened, just as in the case of any other gas.

When an oxide-coated filament is used great care is exercised to make the tube gas free. It is not always easy to remove the last traces, and these remnants have a habit of hiding away in odd corners of the tube. When the tube becomes hot they wander out of their hiding places, and when they get in the way of an electron, ionization takes place. It thus happens that an apparently good tube develops "gas" when put to work.

Constant vigilance on the part of the manufacturer has greatly decreased the chance that such a tube may reach the consumer, but it still occurs because the same forces that hold the volatile metallic barium and strontium to a red hot filament may also firmly hold a thin layer of gas on to the grid or plate. In either case, trouble results. Much of the "static" of the early radio sets was due to this absorbed gas within the tubes.

Plate Construction

In the heavier tubes the plates are blackened, or the surfaces are roughened by sandblasting. Both treatments are for the purpose of dissipating the heat generated in the plate by electron impact, so that the temperature of the plate may remain as low as possible. In this way both back emission and gas troubles are

(*Continued on page* 16)

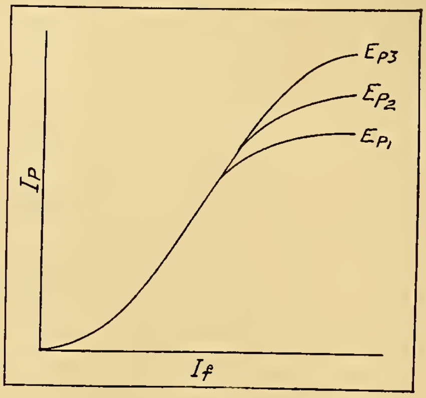


Fig. 2

Sound Ideals in Sound Installations

By R. J. Stier

What constitutes a good sound equipment installation? What should the exhibitor look for and the projectionist expect? In the article which follows, the author tells us precisely what, in his opinion, are the salient features of a good installation and why these features are desirable. Mr. Stier received his engineering training at the Armour Institute of Technology and the University of Chicago. He is at the present time associated with the Engineering Department of RCA Photophone.—THE EDITOR.

AFTER the first showing of "Don Juan" at Warner Brothers Theatre in New York City in August 1926, there was an instant rush to secure sound reproducing equipment for installation in theatres all over the world. Many companies were formed to manufacture such equipment for sale. Some of this equipment was definitely superior in quality and some of it was of an inferior quality, produced solely with a view to profit.

It is needless to state that the installation practice of these various companies differed directly in accordance with the prime object of their existence. Those companies interested in producing sound equipment of as near ideal quality as was possible at the time, insisted upon careful supervision of the installation of their equipment. Those companies selling cheaper equipment—and the word "cheaper" is used in its most significant sense—depended upon the projectionist, uninstructed, to assemble and wire the equipment as best he could. Of the original quality equipments, those manufactured by the larger established concerns were installed completely under the supervision of their engineers and were serviced by engineers skilled in the service requirements of these equipments.

Installation Costs

It was found that the expense of installation was a very appreciable portion of the total equipment expense. Contracts for wiring alone were let at figures varying from $400.00 for the smaller equipments to $2,000.00 or more for the larger equipments. Installation engineers representing the contracting sound company spent from 18 to 21 days, and in some cases an even greater period of time, in supervising the complete installation of equipment. Such supervision included interpreting the wiring diagrams and schedules to the exhibitor's contractor and "spotting" location of equipment. This supervision was deemed necessary because of the opinion that installation of high gain audio frequency amplifiers was something requiring technical supervision to avoid pitfalls which would normally be experienced in installation of this equipment by those not familiar with requirements of this type.

Great stress was placed upon the fact that lead sheathed cable should have no cracks or breaks in its protective sheaths, and that all wiring should be continuous from end to end without splices or joints. Past experience had indicated that the presence of an unsoldered splice in a wire was an almost inevitable source of trouble because of the variation in resistance of a mechanical joint. Chemical corrosion caused by the acid flux solders used by contractors resulted in a series of scratchy noises from the loudspeakers. Expert supervision eliminated the greater portion of these troubles. Furthermore, the extreme sensitivity of the input circuit of a high gain amplifier to low level noises induced by the proximity of weak electromagnetic fields, required carefully executed judgment to avoid noise from that source.

Of the work requiring a highly specialized sound experience and knowledge, it was found that only three or four days were required in the average installation. The balance of the time expended by the installation engineer was spent in supervising the installation of such work as could normally be done by the average electrical contractor if he were provided with suitable instructions. Based upon these facts, large companies reduced the amount of time representatives were permitted to spend on the job, thereby reducing installation costs and reducing the costs of the equipment to the exhibitor. Such condensation of schedules inevitably led to the extemporaneous preparation of instructions to be given to the contractor that he might be guided thereby during the shortened visit of the supervising engineer.

Present-Day Practice

As the practice ultimately worked out the exhibitor is furnished with a carefully prepared installation specification. He is instructed to secure a local contractor to install certain portions of the wiring in accordance with the installation specification with which he is provided. These installation specifications are very carefully prepared by the engineering departments of those sound reproducing companies furnishing their equipment on this basis. Specialists in their respective fields prepare these specifications. They are reviewed and changed, where change is advisable, by others of suitable qualifications. This results in an extremely accurate simplification of the job of installing sound reproducing equipment. The specifications are very carefully prepared to conform with the National Board of Underwriters' requirements. Materials, therein specified for use, uniformly meet all normal inspection requirements. In those instances in which no definite authority is recognized, the specification states that the exhibitor shall perform certain duties in accordance with the requirements of his local fire authorities. In this way all underwriters' requirements, both national and local, are met.

At the time the theatre receives its shipment of equipment, the exhibitor is given a copy of the installation specification by the District Manager of the company installing such sound equipment. The District Manager at that time, or his representative, goes over the specification with the exhibitor, explaining to him the necessary requirements and inspecting the theatre in order that he may suggest to the exhibitor such corrections as may be most advantageously included in the installation of sound equipment. It is to the theatre's advantage to include the projectionist in such conferences.

The Wiring Contract

Following this, it is the duty of the exhibitors to place a contract with a local contractor for the wiring of the theatre. It is of the utmost importance that the exhibitor secure a contractor who has a reputation for doing contracting work in the manner in which it should be done, since any deviation from the specifications will necessarily result in an inferior quality of sound. The specifications require the use of lead covered wires in accordance with detailed drawings furnished as a part of the specifications, it requires the location of pull boxes at distances not to exceed 50 feet, and it requires the enclosure of all booth wiring in rigid iron conduit with the exception of the short connecting pieces to the sound heads.

These requirements are written into the specifications for certain definite reasons. The lead sheathed wire is required as a protection against stray "pickup" of extraneous noise. The rigid iron conduit is specified as it is a requirement of the National Board of Underwriters to protect against fires. Location of pull boxes at distances not to exceed 50 feet is specified to insure satisfactory pulling of long runs in order that kinks and breaks may be avoided in a wire running back-stage to the loudspeaker. The physical location of the equipment is very definitely specified and this requirement should in all cases be adhered to rigorously. It is customary to specify the location of certain pieces of equipment as being certain definite distances from the soundheads or amplifiers in order to avoid the possibility of introducing additional hum. It is also customary to specify that no electrical equipment with the exception of that equipment necessarily associated with the projectors, be placed within a distance of 10 feet of the soundheads or amplifier. These requirements are necessary to avoid reproduction of undesirable noise from the loudspeaker.

Perfect reproduction of sound depends upon a number of individual conditions each of which is relatively unimportant in itself, but the sum of which affects vitally the quality of the program offered to the theatre patrons. The specification always requires certain specific grounding of sheaths and conduit. This practice should be followed explicitly for reasons before mentioned. Wires are required to be tagged in order that they may be easily identified for future service work. Clearance behind, and at the sides of units, is specified in order that adequate operating room may be provided and in order that later service work may be facilitated.

The Ideal Installation

To assist the exhibitor and the projectionist in visualizing what constitutes what might be termed an entirely satisfactory installation and which adheres to specifications, this article will outline an average suitable installation. It can be recognized that numerous minor deviations from this average installation may be permitted without affecting the quality of the sound reproduction in the theatre and in some cases it might be desirable to deviate from this average ideal.

Beginning with the projection room, the ideal installation would find the projectors spaced on 5 foot center lines. Four and one-half foot separation is satisfactory, but the greater operating ease afforded by the greater separation is desirable and should be secured in all cases in which the booth dimensions are such as to permit such installation.

The amplifier rack will be located on a line midway between the two projectors and to the rear a sufficient distance to permit easy passage by projectionist or others who have business in the booth. The monitoring loudspeaker will be located to the left of the lefthand projector, in such a fashion that it is out of the way and yet directs its sound beam across the projection room just forward of the projection lamp houses, and at a height approximately 6 feet from the floor. Under no circumstances will monitoring loudspeaker beam be directed at the amplifier rack since such "acoustic coupling" might introduce microphonic "howls" which would certainly be detrimental to the presentation of the program.

The power supply for this equipment would be brought into a distributing panel located at some convenient point in the projection room. Supply lines from this power supply panel would extend, by way of individual lines, to the required points. Indicating lamps would be included to indicate on and off positions of switches, and fuses of the correct size to allow satisfactory operation without constituting a fire hazard would be included in the panel.

Conduit Runs

All wiring would be enclosed in rigid iron conduit insofar as possible. Connections between rigid iron conduit and terminating equipment would be through suitable "Greenfield" (flexible conduit) and connectors. All conduit would be rigidly fastened to its supporting surface, and to make the job to appear neat and workmanlike, conduit would be carefully leveled and painted with several coats of a suitable black paint. It is unnecessary to state that the inclusion of bends in this conduit is undesirable. Fitting should be substituted.

Back stage equipment, which includes the loud speakers and necessary supporting arrangement and the means of connecting them to the amplifier, would depend upon the conditions back stage. In those installations requiring the clearing of stage space for "flesh" presentations, the loud speakers should be mounted in movable towers or should be flyed from lines in the grids. Junction boxes and connectors would be most advantageously located. In installations utilizing portable towers, suitable casters should be provided in order that the towers might be rolled into and away from the proper place. Provision should be made for "spotting" the correct location of the towers once the loud speakers are adjusted for most satisfactory distribution of sound in the auditorium. Wiring between the booth and the stage would be installed in a similar high quality manner.

In summation, therefore, the installation specification furnished the exhibitor by at least one large sound equipment company outlines the installation of equipment in what might be termed the average ideal manner. This presupposes sufficient space in the booth to permit satisfactory spacing of the equipment and requires the wiring of the equipment in such fashion as to assure maximum operation with minimum interruption of programs. It permits the performance of strictly contractual work before the arrival of the installation engineer. It effects real economies to the exhibitor, relieving him from the expense of two or three weeks of supervisory service and insuring that the necessary time expended by the installation representative is most effectively spent toward producing satisfactory reproduction.

Tubes and Their Troubles

(Continued from page 14)

minimized. In the case of the 211E the plate was made of nickel, and the oxidized surface dissipated the heat.

This type of surface is quite effective as a means of keeping the plate cool, but offers a very high resistance to the plate current, and the nickel-oxide coating is gradually decomposed by electron impact. The gas that is liberated attacks the filament, as already mentioned, and shortens the life of the tube. The most effective surface is that coated with carbon, and where this is not practicable, a sandblasted finish is used. This roughened surface is most commonly used in tubes having an output of 50 watts or more, but is also used in one variety of 210.

Also Common to Photocells

Troubles similar to those occurring in vacuum tubes are also found in photocells. While a great deal of the output of a photocell is due to electrons liberated by bombardment of the active surface by gaseous ions, this effect must be carefully controlled or the active surface may be destroyed by ionic impact. The manufacturer does his part by controlling the gas content of the cell so that no excessive ionization results when the cell is properly used.

If, however, the impressed voltage should exceed the specified value, ionization may increase to the point where a glow discharge sets in. The cell is wrecked in a few seconds when this is permitted to happen. A slower but equally sure destructive action takes place at voltages below those that produce a visible glow but above those that are intended to be used.

The foregoing discussion covers the commoner troubles encountered by the projectionist. It also attempts to explain why they occur, how they may be recognized and, as far as it lies within the operator's power, how they may be avoided. It has been the writer's experience that a simple explanation of a phenomenon is a much more effective means for obtaining intelligent use of a delicate instrument than is a book of rules. This has been the guiding thought behind this article.

E. R. P. I. to Make Eight New Ship Installations

With the announcement of C. W. Bunn, General Sales Manager of Electrical Research Products, that eight Western Electric Sound System installations have been completed on seven round-the-world liners of the Dollar Steamship Company, the equipment ranks as the most widely traveled in the world. Eight more installations on additional steamers of the company are to be completed in the future.

Engineers Score Film Mutilation

The subject of film mutilation is one of paramount importance. It has been characterized as one of the most serious evils now confronting the industry. That it is now more than ever before being given the attention and consideration which it deserves is indicated in the following abstract from the Report of the Projection Practice Committee of the Society of Motion Picture Engineers.—THE EDITOR.

THE Projection Practice Committee wishes to direct attention to what it considers one of the foremost causes of waste and monetary loss suffered by the motion picture industry, namely, the mutilation of positive prints. This mutilation not only results in a considerably shortened life of the individual print, which is serious enough in itself, but in addition to this, it is impossible to obtain the optimum screen results, which are so highly important in creating the proper illusion so necessary to the motion picture play. Both picture and sound are affected by mutilation of film.

It is generally understood that the mutilation of film is frequently due to the maladjustment of projector parts, wearing of projector parts, accumulation of emulsion during projection, excessive oiling of projector or leakage of oil, and careless handling of film. The Projection Practice Committee is of the opinion that there is urgent need for the establishment of standards dealing with the various tensions to which the film should be subjected during projection, the clearances of adjacent projector parts and sound apparatus, allowable tolerances, and the amount of wear projector parts may suffer without impairing the quality of the picture or causing mutilation of film.

Investigation Recommended

The committee, therefore, plans to conduct a thorough investigation which will be nation-wide in scope, with the view of obtaining all necessary data for submittance to the Society for the purpose of adopting such standards. In order to accomplish this, the committee requests the earnest cooperation and support of the Society as a whole, as well as of associated individuals and organizations. Their assistance will be needed as this work will be of considerable magnitude and should, when completed, prove invaluable to the industry.

The Committee wishes also to call attention at this time to the lack of uniformity in the processing of prints, which constitutes another serious loss. In regard to the processing of film, there seems to be no standard for this work at the present time. One producer uses a certain method of processing film; another producer simply waxes the margins of the print; and a third producer does not process the print at all. This condition works a hardship on all concerned, inasmuch as it frequently happens that the producer who has processed his product suffers by reason of the fact that the theater uses unprocessed film at the same time. This evil adversely affects both the sound quality and the quality of the picture.

Film Processing Considerations

It is well known that with unprocessed film there is a tendency to accumulate emulsion at the tension points in the projector. Formation of emulsion greatly increases the tension applied to the film and imposes a strain on the sprocket holes. Occasionally a positive print is irreparably damaged during its first projection. The Projection Practice Committee recommends that a thorough investigation to find the best method or methods of processing film be conducted by a designated committee of the Society so that such methods may be recommended as a standard for the industry.

Unless such a standard is adopted, generally accepted, and put into use by the producers of film, the industry will continue to suffer the great loss now occasioned through faulty (or the lack of) processing methods, and such benefits which should accrue through the adoption of the standards relating to projector tensions, adjustments, *etc.*, would be largely nullified. In the opinion of the Projection Practice Committee, such a work is one of the most important contributions the Society could make to the industry.

DISCUSSION

MR. MCGUIRE: For quite a few years I was one of those who vigorously protested against the neglect of projection by this Society, but no longer have I any cause for complaint as we have our own Projection Practice Committee and it is up to ourselves to make good. In discussing the Report of the Projection Practice Committee it is not my intention to complain or criticize, but to offer some suggestions which I hope will be helpful to the motion picture industry and a benefit to the Society of Motion Picture Engineers.

I ask you to be patient because much of what I will say is to be of a somewhat general nature and perhaps out of place in the proceedings of this Society. But most of the papers and much of the discussion of the Society are more or less incomprehensible or relatively unimportant to some part of the membership of this organization.

In order to deal only with subjects which would be of interest to everyone it might be necessary to hold a hundred conventions or divide the meetings into an equally large number of groups. In its proceedings, the Society of Motion Picture Engineers must give some attention to invention, development, manufacture, maintenance and operation, the electrical, chemical and mechanical divisions of the industry, visual and sound recording and reproducing, and always theory and practice. These are rough classifications, but give a general idea of the vast field the Society must cover.

Purpose of the Society

The Society of Motion Picture Engineers is not a scientific body seeking abstract truth, but a technical organization with a very definite commercial background. When we lose sight of the fact that we are part of the motion picture industry we fail to realize the true purpose of the Society. It, therefore, seems to me that anything the Society can do to render a practical service to the industry should result in the organization receiving increased support.

The benefits that the industry has derived from the Society of Motion Picture Engineers have not always been recognized because they were often of an extremely indirect and intangible nature. The fact that the Society has for many years focused attention upon the technical side of the motion picture industry and to some extent has won the interest of non-technically minded executives is in itself a great achievement. The executives of this industry have never given the Society adequate support, and I believe that the producers and exhibitors have contributed more to a single activity of another organization in this field than they have to the Society of Motion Picture Engineers in its entire history.

The Society is facing new conditions and it is desirable that the service which it renders the industry should be more direct and more obvious. If this can be done, the Society will receive increased support and be in a better position to carry on its important work. This organization is in a particularly strong position to secure technical data regarding the cause and prevention of film mutilation. Various attempts have been made to get this information, but there is good reason to believe that the results have not been entirely satisfactory.

Someone has said that "science is common sense made exact." The

Projection Practice Committee will conduct a scientific survey, collecting the facts systematically and thoroughly, and present them in an authoritative report. When this is done definite action should result and the Society will have rendered a service comprehensible in terms of dollars and cents.

Time and Expense Involved

The work we are undertaking, however, will involve considerable time and expense, and should receive adequate support from the Society as well as the industry. It is an unfortunate fact that the industry does not take proper interest in the collective thought developed by such an organization as the Society of Motion Picture Engineers. Progressive projectionists in this organization, and their own projection societies, are constantly giving their own time to do valuable technical work without receiving the least recognition from the executives of their own firms. Conceding that this is a period in which executives are very properly insisting upon economies, it nevertheless seems unwise to ignore totally all the collective effort for the betterment of the industry.

Back of the artistic side of the motion picture industry is a vast technical field whose work offers infinite opportunity for flaws and failure. Motion pictures provide entertainment and education through chemical, mechanical and electrical processes. What the public pays for is not the product of a single commercial organization, and it is important that the Society of Motion Picture Engineers should bring this to the attention of the industry—emphasize the interdependence of the various departments and point out the need for coordination.

Benefits Derived

In all work which is not of a competitive nature the industry benefits tremendously from the collective thought developed in such organizations as the Society of Motion Picture Engineers. I sincerely hope that a way will be found to encourage and finance adequately the efforts of the Projection Practice Committee to find the cause and prevention of film mutilation. The men on this committee have the technical and practical experience to do the work. Their report should result in a tremendous saving through prevention of waste and the improvement in screen presentation.

PRESIDENT CRABTREE: I indorse Mr. McGuire's remarks one hundred per cent. Of course the world was not made in a day. But it is encouraging that the producers have shown a much greater willingness to do things for us at this convention than at any time previously.

MR. SUMNER: I happen to be an exhibitor, and this report of the committee was very interesting to me. We happen to run a theater that is called a "first subsequent run"; that is, we run after the key point in this district, which is Boston. I have attended a number of the conventions, and have heard the reports from the various specialists in the studios; and I realize the great amount of thought and work that is put into the pictures, the great mass of work that has been done to accomplish perfect sound, and so forth.

An Exhibitor's Views

And yet, when these prints get to the theaters, the greater part of that work has been ruined by improper handling of film. As an exhibitor, I wish to state that I believe that the work that has been begun by this committee is most important. I want to urge them not to stop with the problem of processing film. They must go much further than that.

In spite of the noiseless recording system, the prints reach the theaters so dirty and scratched that the work of noiseless recording has almost gone for naught.

I think this committee is one of the most important factors in the organization and I want to urge that it be given all possible support in its work.

PRESIDENT CRABTREE: I should like to ask Mr. Griffin: Was the accumulation of emulsion due to friction along the perforations, or at some portion of the picture area? In other words, is it necessary to process the entire surface of the film, or merely the edges of the perforations?

MR. GRIFFIN: For projection purposes it is necessary only to process—or lubricate, as it may be called—the edges of the film in the sprocket hole area.

MR. FAULKNER: As Mr. Griffin says, as far as passing the film through a projector is concerned, it is only necessary to lubricate the margin of the film. The emulsion that is on film, unless the metal parts with which it comes into contact are lubricated, is quite likely to stick. Therefore, the film is lubricated for the purpose of keeping the tension shoes lubricated.

New Term Required

Mr. Rubin asked me to present to you his idea that "processing" is an incorrect term to use for this process. He wants to find a name for waxing, treating, processing or "whatnot," and to standardize that name. I went to a dictionary and ran down every name I could think of. I have a great number of them, none of which I think would be appropriate, except perhaps "treatment" or "finishing" or the like. "Processing" is used to indicate anything that may happen to film from the time it is printed to the time it is developed for screening.

PRESIDENT CRABTREE: Why not use the word "conditioning"?

MR. FAULKNER: Some of the names I accumulated are: hardening, completing, seasoning, curing, impregnating, finishing, duratizing, dura-proofing, inuring, toughening, preserving, protecting, treating, perfecting treatment. None of these I think would be satisfactory except perhaps "conditioning" or "treating." I do not like "processing," nor does Mr. Rubin.

MR. MCGUIRE: I ask you not to exaggerate the importance of "processing" merely because it has received special attention in this discussion. It is a serious problem, but we shall have other important subjects to consider in our efforts to find the cause and prevention of film mutilation. There has been much talk in the past about film mutilation and various organizations have dealt with it rather unsuccessfully.

End of Film Mutilation

The Projection Practice Committee is starting out with the idea that there seems to be an evil which is called film mutilation, but that it knows absolutely nothing about its cause and prevention. We hope to be able to gather some data in the next six or twelve months, which will save the motion picture industry a tremendous sum every year and greatly improve the quality of screen presentation.

MR. J. CRABTREE: I think a little more attention to the projector is what is necessary. I often project green film, and find that as long as the projector is kept in shape, little trouble is experienced.

MR. GRIFFIN: I must take exception to that. I don't know under what conditions Mr. Crabtree projects his prints, but I defy anybody to take a piece of green film off the drying rack and project it under conditions existing in the theater today and not have it seize up, no matter how well the projector is designed.

PRESIDENT CRABTREE: Are you speaking now of a film to the edges of which wax has been applied?

MR. GRIFFIN: Mr. Crabtree said he would use it without treatment—right out of the laboratory. It is not waxed there. Now, waxing is not the solution, apparently, because the wax peels off and rolls up. With the old silent machines, waxing was all right. Today we have sound. The wax rolls off, gets in the sprocket holes and is carried to the sound gate, where it either leaves the film or raises it off the sound gate.

PRESIDENT CRABTREE: You are speaking of the old method of waxing with solid wax?

MR. GRIFFIN: Yes.

PRESIDENT CRABTREE: You should use a solution of wax in a solvent. It is only necessary to put on a layer of wax a millionth or so of an inch thick, to provide the necessary lubrication.

MR. GRIFFIN: I have seen, in cases where the film is put on a rewinding device, two pieces of tallow right at the sprocket holes, over which this film is drawn. The projectionist should be taught not to do a thing like that. We must find a proper means of treating the film so that during projection under high amperages it does not seize in the tension parts of the projector.

PRESIDENT CRABTREE: Of course, Mr. Crabtree is not projecting under the high amperages that you speak of.

MR. FAULKNER: When the film comes off the drying cabinets and is projected for inspection, felt runners are used in some places, and I know one laboratory that does not use them. They never scratch film, but it is due to the fact that there is no heat on them.

MR. GRIFFIN: We supply thousands of different types of runners to the laboratories of studios, and I know how they work. They use a Mazda lamp, and very little light.

PRESIDENT CRABTREE: I happen to have done a considerable amount of research on the lubrication of film. Our researches have shown that if you have even the merest trace of wax or oil or grease or any lubricant on the film it makes a tremendous difference in the ease with which it passes through the projector. To date we have not found that any special processing treatment is any better with regard to lubrication.

The Anastigmat Lens in Projection

(*Continued from page 7*)

lar angle. The location of all points t′ and s′ for the whole field of the lens is a pair of curved surfaces indicated by the dotted lines in Fig. 5, which will vary in their departure from the focal plane as the field angle increases or decreases.

This illustrates astigmatism in a single lens. In compound lenses composed of several elements the situation is more complex and the curved image surfaces can be brought together and flattened out to some extent, so that they are closer to the ideal focal plane. It is possible by using the proper proportions in convex and concave elements and by choosing glass and curves to the best advantage to design lenses that are corrected both for astigmatism and curvature of field. When this additional correction is combined with freedom from spherical and chromatic aberration, a lens so corrected is called an anastigmat and will be found to give critical sharpness over the whole area of its field.

Correction for Astigmatism

The extent of these corrections naturally varies a good deal with different forms of lenses. A comparison of the marginal definition of the same three types as previously considered is shown in Fig. 6. B is a Petzval lens with curves fairly flat out to 7 degrees from the axis. C, the short back focus unit, shows astigmatism well corrected, but a noticeably curved field.

Curve A demonstrates the value of anastigmat construction, with a field that is almost plane even at 14½ degrees. The meaning of these curves will be clearer when compared to the fact that a 5-inch lens must include 7 degrees on each side of the axis on standard film. A 4-inch focus must cover 9 degrees.

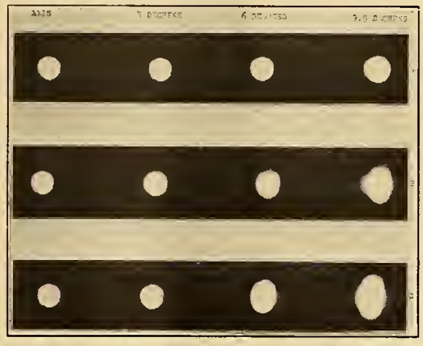


Fig. 7. Projection Lens Test Plates

Practical trials by projectionists in the theater have confirmed the above conclusion in the many cases where anastigmats and other types of projection lenses have been subjected to comparative tests. The curves shown in the above illustrations were drawn from measurements made on the optical bench. They are precise and reproducible but are not easily interpreted into the results of ordinary practical experience.

Testing Procedure

Now it is no easy matter to find a means of testing lenses in which results can be easily expressed and reproduced without loss of detail. The screen image in a theater is so large that it would be hard to record the definition directly on a negative exposed at the plane of the screen. Any other photographic method involves some uncertainty when a camera and its lens are introduced into the process. Therefore, the direct method has been attempted and the results are shown in Fig. 7.

In this testing process a metal plate with a small hole bored in it is used in the film plane and the lens is lined up and focused to project the image of the pinhole on a photographic plate in the screen position. The pinhole is illuminated with diffuse light to make sure of filling the entire lens aperture and the plate exposed to record the image that it receives.

Plate and pinhole are movable and carefully aligned so that definition can be tested at any selected point from the center of the screen to the edge by successive exposures. The use of panchromatic plates makes the test sensitive throughout the whole color range of the visible spectrum.

The projection lens test plates shown in Fig. 7, although made at about one-fourth the magnification used in modern theatres, are still large enough to show clearly the differences between the three forms of projection lenses. The same letters are used as before. A for the anastigmat, B the Petzval objective, and C the projection lens of the short back focus type.

The size and shape of the projected spot of light shows the quality of definition that each of these lenses will give. Four exposures were made for each lens, one on the axis or center line; one is at 9½ degrees, the extreme corner of the film gate aperture; the other two are at intermediate points between center and margin, as indicated. The difference in marginal definition is apparent.

These test plates are in good agreement with the conclusion drawn from measurements on the optical bench, which can be summed up as follows. The older types of projection lenses such as the Petzval and forms derived from it give good definition as far as the center section of the screen is concerned. Anastigmats now available have made it possible to extend this critical sharpness over the whole area of the screen image, and this extra covering power is a distinct improvement with the larger screen sizes that are now being used.

J. R. McDonough Elected President of RCA Victor

David Sarnoff, President of the Radio Corporation of America, announced that at a meeting of the Board of Directors of the RCA Victor Company held recently, Mr. J. R. McDonough was elected president of the RCA Victor Company, to succeed Mr. E. E. Shumaker, the former president, whose resignation became effective December 31, 1931.

Mr. McDonough, who is thirty-seven years old, entered the employ of the Radio Corporation of America in 1924 and has acted in various capacities since that date. He has been Assistant to the President of the Radio Corporation. During 1931 he assumed the duties of Executive Vice-President of RCA Victor Company.

Outline of Sound Recording

By GEORGE DOBSON †

The author concludes in this issue of our magazine his treatise on the subject of sound recording with a description of the actual operation of the equipment, the various units of which he has so ably discussed in his previous installments. The Motion Picture Projectionist wishes to take this opportunity to express to Mr. Dobson its appreciation of the splendid service which he has rendered its readers through the medium of this interesting and instructive serial article.—THE EDITOR.

Part VI.

IT might be advisable to stop at this point to consider just what we mean by a "scene." The ease with which the motion picture can cut from place to place and from one viewpoint to another is one of its great advantages over the usual theatrical production. In this respect the motion picture more closely resembles one of Shakespeare's plays than it does a modern play. Therefore, in Shakespeare and in the motion picture play as we all know, scene follows scene in rapid succession, none of them being much over three minutes and many of them running a minute or less.

This characteristic of the silent motion picture has carried over to the speaking picture and directors and actors work in scenes carefully timed, so that they know just how long each takes. Should a scene be too long the script will be revised and the verbiage carefully pruned. Therefore, sound is recorded in short units and while the discs and sound recording machines are fully capable of recording a complete reel of ten or eleven minutes in length, they actually record a number of short scenes, which can be later arranged in the desired order.

Rehearsal and Volume Regulation

Returning now to the taking of one of these scenes we notice that during the final rehearsal the monitor listens with great care and watches his volume indicator meter to determine whether the recording is loud enough and also whether it is too loud. The range of loudness in any given scene is usually not nearly so great as it is within the picture as a whole. Therefore, it is the practice, in order to keep the sound as high above the noise level of the film as possible and in order not to lose any weak sounds, to record at the highest practical volume. Later this volume will probably be reduced by re-recording methods which we have still to discuss.

In the early days of recording it was the practice, following the broadcasting experience of most monitors, to be continually adjusting the volume during the recording. This, however, does not usually result in a satisfactory "take." It is, therefore, now the practice to find during the rehearsal a proper single adjustment which may be left set during the "take." Occasionally this results in a bad "take" since the actors do not always speak in the same loudness of voice, but the practiced monitor soon learns to make proper allowance and the number of sound "N.G.'s" for this reason is small.

As already mentioned, any undesired sound occurring on the stage, such as somebody sneezing, a carpenter dropping a hammer or somebody rocking a creaky chair, will make it necessary to "N.G" the sound and have an immediate "retake." In addition, the director usually will not be satisfied with one "take" but will require two or three, and one very prominent director has been known to require habitually between fifteen and twenty. Frequently complete close-ups and long shots of the same scene are taken in sequence so that they can be intercut later. The net result of these conditions is usually several takes of the same scene, one following another, all immediatelv after the rehearsals.

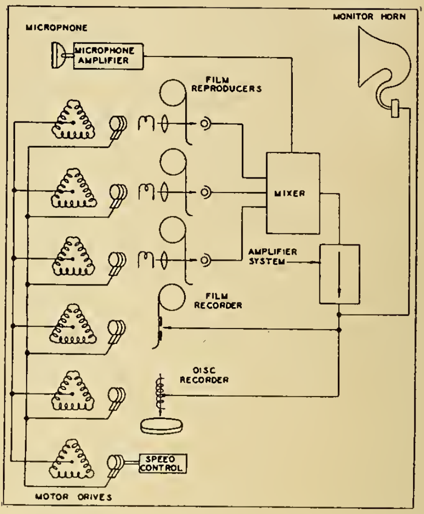


Fig. 21. Set-up for Re-recording

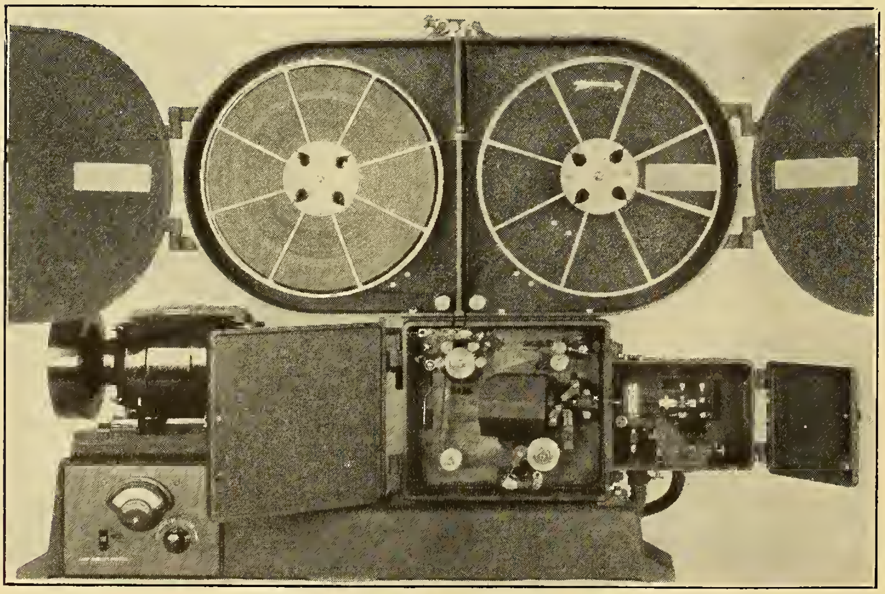


Fig. 22. The Re-recording Machine

A Technical Dr. Syntax

During these "takes" the monitor, if he has done a first-class job, will have to listen only for accidental reversal of words, stentorian expressions and other undesirable noises. His skilled work has been done in the proper placement of the microphone and the proper adjustment of the volume controls previous to the take.

There are occasional scenes in which cuts are made from one microphone to another during the same "take." This usually occurs when the action cuts in close-up from one person on a large set to another person on the same set. In such case the monitor must switch his mixer dials at the proper moment.

During the rehearsals the sound crew has been standing by listening through a small loud speaker in the recording room or by means of headsets in the amplifier room. As soon as all is ready for the "take" the director tells the monitor that he is ready and the monitor calls through his loud speaker, "Silence, please, this is a take." At the same time a loud bell is rung three times and the monitor presses the button which lights the get-ready lamp at each signal position.

---

† Commercial Engineering Dept., Electrical Research Products, Inc.

Starting the Equipment

The amplifier man, if he has not done it just previously, checks up on all the amplifier settings and upon the currents in the vacuum tubes. This insures that the amplifiers shall be in the best possible operating condition. At the same time, whoever is responsible for the motor drives (usually the film or disc man) synchronizes them by connecting the fields to the A.C. supply. He then presses his signal button, which lights the second lamp at each position (stage, monitor booth, amplifier room and recording room) as well as a warning lamp at the motor patch panel and a similar one at the distributor control box.

When they see this signal the disc recorder man lowers his stylus on to the wax and the film men mark a starting point on the sound films. The camera men on the stage also make a starting mark on their film and then close their cameras and blimps. Each of them then informs the monitor, usually by a signal light or by calling out, that he is ready.

The lights are often partially turned off during the rehearsal or during the period allowed for the actors to renew their make-up. Therefore, the director now calls "Lights" and the electricians turn on the full power of the various lamps previously arranged by the camera man. The director then announces "get ready" or "take your places."

As soon as the actors are in position the director signals his assistant, who presses the start signal button. The recorder then closes the motor starting switch. As soon as the motors are up to speed, as indicated by a little meter device in front of the recorder, he presses another signal button which lights the final lamp at all points and the director immediately starts the action.

During the scene no interruptions are allowed unless a serious error occurs in the action or unless some accident occurs to a camera or in the recording equipment. If any of these happen the action and machinery are usually stopped immediately to save film.

At the End of the "Take"

As soon as the action is over the assistant director turns his key, thus extinguishing the corresponding signal lamp. Upon seeing this signal the recorder stops the motors without, however, opening their field circuits. This insures that the motors shall keep in step while stopping and that none of them shall run away with possible damage to film or disc. As soon as the motors have stopped the signal lamps are extinguished and a single bell is rung to indicate "all clear." The stylus is then lifted from the wax and the recording and camera men mark their film to indicate the end of the "take."

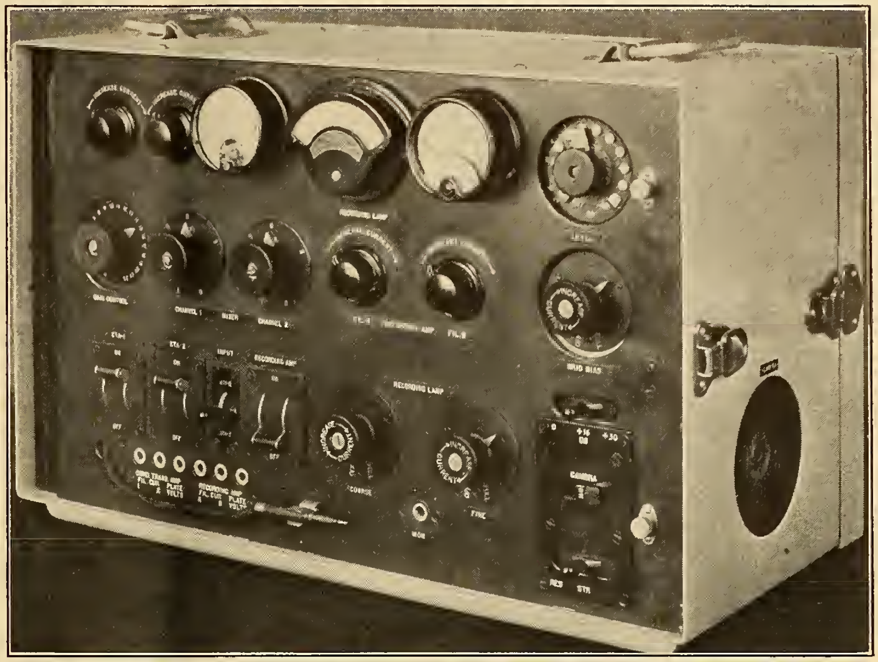


Fig. 23. A Typical Simplified Amplifier

Should a playback be required exactly the same procedure is followed as if a regular "take" were being made. As the end of the "take," however, the disc recording man replaces his recorder with a playback similar, except in minor details, to the ones used in theatre disc reproducing.

The changes in the playback reproducer, particularly those in the needle, are to take care of the difference in the effect upon the playback of the relative softness of the wax. This playback is connected through the necessary amplifiers to the loud-speaker in the monitor booth and to a loud-speaker on the stage. This enables the director, actors and monitor to listen to the whole "take" and determine in what points it needs improvement.

Development and Printing

During the interval between the "take" and the next day, the picture and the sound films are developed and a print made from the negatives. In some cases a single print is made combining both sound and picture, and in other cases separate prints are made. When these prints are completed the director and such others as are necessary will listen in the review room to the separate scenes and determine which "take" of the several made is to be used; this before any cutting is done.

Very frequently, after a "take" has been selected as being the more desirable and it has been associated with the previous and subsequent scenes in the proper order, it is found that the match-up is not as good as it might be, so none of the original "takes" is destroyed until after the picture has been cut.

It has been probably noticed that in discussing the "shooting" no mention has been made of the introduction of noises and of music. Some companies still adhere to the practice of using music when required upon the scene during the recording of the conversation. However, most of them prefer to introduce it later during the re-recording. In fact, many effects such as walking, where the walking may lend emphasis to the scene, are introduced as effects rather than by recording the sound during the "take," so we find that a few silent scenes are still being taken.

Scoring the Picture

Where a musical background is required to be introduced later, it is the usual practice after the positives have been cut to make a trial run. The director, musical director, score writer, etc., sit down and watch the picture run complete with sound and decide where the music is to come. The score writer then proceeds to write the score of the proper length to match it, if this has not already been

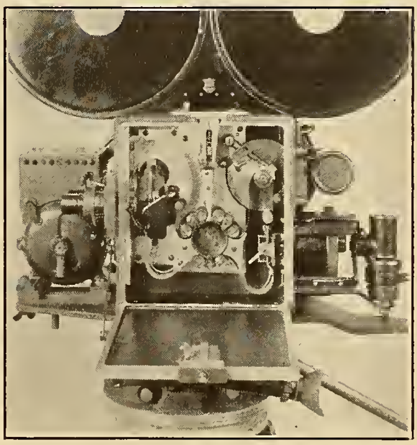


Fig. 24. Camera for Newsreel Work

done. If it has, he will, of course, have to modify it in order to obtain the proper length. The picture is then run without sound while the musical director rehearses his orchestra.

There remain two ways of recording the music; first, to record it separately and then to re-record it with the other sound. This, of course, enables a much better adjustment of the relative volumes. If there be considerable pressure to get the picture out it may be desirable to use the second method, which is to record both music and voice on a new record at the same time. In any case, the monitor must listen to the music and voice, and adjust their relative volumes.

To obtain the best effect, special scoring stages are used for the music and, as a rule, a single microphone is used and carefully placed at the best position for music pick-up. Except in the length of the "take" the recording of music does not differ appreciably from the recording of conversation.

Two Types of Re-recording

From the above it will be apparent that two types of re-recording are done; one, the introduction of music and effects in a given scene, and the other, the adjustment of the relative volume level from scene to scene. These may be done separately or at the same time. However, it is advisable not to record too frequently as there is a slight, although almost imperceptible degeneration of the sound quality for each re-recording.

The set-up for re-recording is shown in Fig. 21. All the re-recording machines are run in synchronism with the recorders and a projection equipment for as a rule the monitor, who adjusts the relative volume of sounds and cuts the noises and effects in and out, has in front of him the picture which goes with the sound record. This is necessary when noise and effects must be carefully synchronized and is of great help in determining the proper changes in loudness.

A re-recording machine is shown in Fig. 22. When re-recording is being done only to adjust the loudness of the sounds, one of these machines will be used, for the introduction of noise and music, more are necessary. If the music or effects have not already been recorded separately, the microphone shown at the top of the diagram will also be required.

Because most of the work is done in the studio and because the more complete equipments are used there, the above discussion has been restricted to motion picture studio recording equipments. Obviously, such an equipment would be impossible to transport from place to place and set up wherever it might be necessary to make location shots. As such shots form an essential part of many pictures, special recording equipments have been evolved to take care of them. Such equipments have some very definite limitations; usually only one recorder is used, although in a few cases playbacks have been provided. The battery and power supply is cut to a minimum. Incidentally, it is the battery and power equipment which constitutes most of the weight of the portable equipments.

Arrangement of Amplifiers

The amplifiers are usually associated in a single unit which also contains the controls for the lamp current, etc. The bridging amplifier, used where more than one recording machine is advisable, may be omitted and usually is. The attenuator, usually inserted just before each recording machine, so that the relative volumes may be properly adjusted, is likewise omitted.

To simplify the circuits and reduce the number of units most of the switches and control parts are assembled as part of the amplifier unit. A typical simplified amplifier of this type is shown in Fig. 23. Associated with it in use are a recording machine, one or more cameras and the necessary battery and drives.

Although it has not been emphasized, it probably has been noticed that the previous discussion has been confined to recording on a separate film. This has a number of advantages, both in the photographic development and in the cutting of the film. However, the use of a separate recording machine involves considerable weight, so on newsreel work and on some location work, it has become the practice to record the sound on the same negative as the picture. This is done by so modifying the camera that after passing in front of the camera lens the film passes through a sound gate.

Associated with this sound gate is a complete unit, consisting of lamp, light valve and the necessary lenses for focusing the sound on the film. This is usually placed in the back of the camera. (See Fig. 24.) The camera is, of course, motor-driven in order that the sound may be recorded at constant speed, but the speed control can be placed in the hands of the camera man and a simple D.C. motor used. While the speed of this motor may vary from "take" to "take" it can be kept sufficiently constant during any one "take" to avoid flutter effects.

Newsreel Recording

We all recognize that newsreel quality is, as a rule, not as good as the quality of a sound record made in the studio. This is particularly true of music, since changes of speed will shift the apparent pitch of the instruments and even though the changes are very slow, experienced musicians will recognize this change in pitch and rightfully criticize the sound.

Again, rapid changes in speed, even though in very small amounts, will cause a wavering or flutter in a long-drawn musical note, which is more noticeable than a similar wavering in speech. The presence of flutter in a reproduction does not necessarily indicate that it is in the record, for it may also be due to irregularities in the driving mechanisms of the reproducing equipment.

Any of these equipments may be, and at times is, used for the recording of sound without a corresponding picture. For broadcasting work the disc has obvious advantages over the film, particularly since in sponsored programs the record will be used only once. While equipments have been planned using film to replace the phonograph disc, none of them is yet in commercial use.

The above outline of sound recording is, of course, far from complete. Many interesting phases and problems, both technical and commercial, have not even been mentioned. Nevertheless, it is hoped that sufficient detail has been given that those who have read this outline may more readily grasp the connection between the many discussions on specific problems which they may meet.

THE END.

---

16 mm. Sound-On-Film Equipment

(*Continued from page* 12)

its carrying case. A sufficient volume of sound is available to meet the requirements of rooms having a cubic content up to 10,000 feet.

The 16 mm. film employed for the reproduction of sound pictures by the Junior Portable contains sprocket holes on one side only instead of both sides as are required by the 35 mm. film. When threaded into the projector, the sprocket holes are on the right side of the film. The sound track, barely discernible to normal sight, is at the left.

The combined weight of both the projector-amplifier unit and the loudspeaker unit makes the apparatus easily transportable. The mechanism of both units being easily accessible, each can be made ready for operation within a very few minutes.

As has been the policy in connection with the distribution of the RCA Photophone 35 mm. Senior Portable, the Junior Portable will be marketed through dealer distribution. The reduction of existing 35 mm. subjects to 16 mm prints, along with the recording of sound upon 16 mm. negative, will make available a tremendous library. Millions of feet of 35 mm. silent pictures will be reduced to 16 mm. subjects within the next few years.

Factory production of the Junior Portable has begun, it is said, and deliveries to dealers will begin within the next thirty days or so.

Theory and Fundamentals

By W. W. JONES

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Engineering Department of RCA Photophone and has been closely identified with the educational activities of that organization since the time of its inception. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that institution.—THE EDITOR.

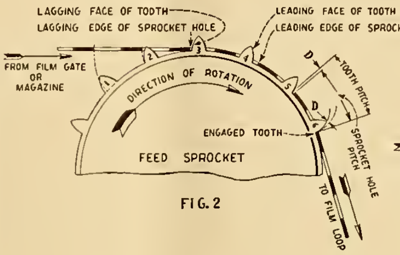


FIG. 2

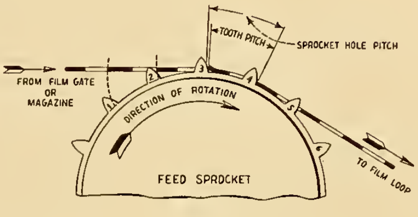


FIG. 3

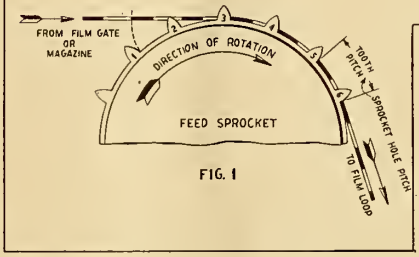


FIG. 1

Some Facts Concerning Film Drive Sprockets

THE film drive sprocket is the common and almost universal means used in propelling motion picture film through the various mechanisms in the modern projector and sound reproducing equipment. The sprocket drive is of necessity used because of the requirements imposed by picture projection. It is not desirable, from the point of view of sound reproduction as explained later, to use a sprocket drive in the sound reproducer. It is, nevertheless, essential to use a sprocket drive in the sound reproducer in order to maintain synchronism between the sound and picture.

For purposes of this discussion, sprockets as used in picture projectors and sound reproducers are classified under two main divisions, viz.: (1) Feed Sprockets, and (2) Hold-back Sprockets.

The first division, feed sprockets, may, from the point of view of operation, be classified further as follows: (1) The upper feed sprocket—used to pull the film from the upper magazine and feed it into a loop just ahead of the picture gate, (2) The intermittent sprocket—used to pull the film through the picture gate and feed it into a loop just ahead of the lower take-up sprocket, and (3) The sound sprocket (often called constant speed sprocket)—used to pull the film through the sound gate or trap.

The second division, hold-back sprockets, when applied to sound and picture projection equipment, may be sub-divided as follows: (1) Lower hold-back sprocket—used as the last drive sprocket in the projector to hold the film back and maintain a loop of film between itself and the intermittent sprocket to prevent damage to the film, and (2) The Lower take-up sprocket—used as the last sprocket in the sound reproducer to hold back the film from the pull exerted by the lower take-up reel, and to maintain a loop of film between itself and the sound sprocket to prevent interference with the sound.

The Feed Sprocket

The upper feed sprocket, the intermittent sprocket, and the sound (constant speed) sprocket are designed with particular regard to the duties and requirements of each. Since the duties of each sprocket differ, it is logical to assume that their shape and general appearance will be different. For example, the sound sprocket, on general examination, will be found to be similar in appearance to the upper-feed sprocket, except taper pins are used to fasten the sound sprocket to the shaft, whereas set-screws are used on the upper-feed sprockets. The intermittent sprocket will be found to differ in appearance considerably from the sound and upper-feed sprockets, and may particularly be characterized by its light weight. These differences in appearances will be explained in the discussion which follows.

The primary purpose of the sound sprocket is to impart a uniform speed to the film passing through the sound gate. In order to approach this uniform speed the dimensions and conditions referred to in the following must for all practical purposes be perfect. The sprocket shoulder on which the film rides must be circular and concentric with the shaft on which the sprocket is mounted. The sprocket pitch or the distance between each successive tooth must be uniform. The diameter of the sprocket and the shape of the teeth are of great importance and will be discussed in detail later in this article.

It was stated above that certain of the dimensions of a sprocket must be, for all practical purposes, perfect. Obviously these dimensions cannot be made perfect, but they can be maintained with proper machinery and properly experienced mechanics within certain specified tolerances. As an example of these tolerances, one particular manufacturer maintains a tolerance of plus or minus 0.00005 inch in variation between successive tooth pitches.

Since very close tolerances are maintained, not only on tooth pitches, but on base diameters and eccentricity of the sprocket shoulder with the shaft bore, we can readily see why taper pins are used in preference to screws in attaching the sound sprockets on the shaft. If screws were used they would have a tendency to cause the sprocket to run eccentrically. The use of taper pins on the sound sprocket will usually differentiate between it and an upper-feed sprocket on which set screws are used. It is also customary practice to maintain the tolerance closer on sound sprockets than on upper-feed sprockets.

Maintaining Tolerances

The intermittent sprocket must be manufactured within the same tolerance requirements as those for the sound sprocket. In addition to this, the weight of the intermittent sprocket must be made as light as possible. This additional requirement of weight is imposed because the sprocket has to start and stop 1,440 times a minute. You will note also that the intermittent sprocket is attached to its shaft by means of taper pins in order to reduce weight and to reduce the possibility of eccentric operation caused by the use of screws.

The upper-feed sprocket in general does not affect the performance of the machine so long as it continues to feed film to the picture gate without damaging the film. Therefore, it might appear at first glance that the upper-feed sprocket may be a relatively crude affair; however, this statement does not apply, since it is necessary for all sprockets to be manufactured within certain tolerances in order to preclude the possibility of excessive wear on film or possible damage to film. It is true, however, that a set screw may be used to fasten the upper-feed sprocket to the shaft and thus it may be identified from a sound or constant speed sprocket.

Careful Manufacture Required

In order to obtain proper sound reproduction the sound sprocket presents a more or less difficult problem in design. Once the design is complete a second problem of manufacture exists. In the manufacture of sprockets special machinery and tools are required and properly trained and experienced mechanics are needed to operate the machinery.

The intermittent sprocket and the sound sprocket are the most important sprockets in the projector and sound head film drive. The intermittent sprocket is used to pull the film through the picture gate, intermittently stopping each successive picture frame accurately in the picture aperture and in the same relative position as the preceding frame. Certainly if the sprocket is eccentric or if the teeth are not spaced uniformly around the circumference of the sprocket, it will be impossible to fulfill the above conditions. It may be repeated that the tolerances of eccentricity and tooth pitch must be held within very close limits, since any variations or inaccuracies in manufacture will be magnified on the screen in an amount equal to the degree of magnification of the picture on the screen.

The sound sprocket is used to pull the film through the sound gate at a constant or uniform speed. As in the case of the intermittent, very close tolerances must be maintained in manufacture, since any variations will result in a varying film speed which introduces distortion in sound reproduction. This distortion can be recognized as a harsh or raspy sound noticed particularly on higher frequency notes produced by such instruments as the piccolo, flute or violin. It might also be pointed out here that even though the proper tolerances may have been maintained, poor or distorted sound will result if the sprockets have not been designed properly or if sprockets are not used for the purpose for which they were intended.

Effect on Film

In the following will be discussed the effect of using a sprocket having improper diameter and improper tooth shape. While all of the comments are made with reference to the sound sprocket, they are applicable as well to the intermittent sprocket and the upper-feed sprocket.

The sound sprockets will be considered under actual operating conditions for the following three cases, viz.: (1) in which the sound sprocket tooth pitch is equal to the sprocket hole pitch as shown in Figure 1, (2) in which the tooth pitch is greater than the sprocket hole pitch as shown in Figure 2, and (3) in which the tooth pitch is less than the sprocket hole pitch as shown in Figure 3.

Figure 1 shows a feed sprocket rotating in a clockwise direction and pulling film from a magazine or through a picture or sound gate. It is to be noted that Figure 1 represents an ideal case, in which the sprocket hole pitch is equal to the tooth pitch. Also, it is to be noted that each sprocket hole is engaged with a tooth and is sharing its equal portion of the load.

For a condition of this sort it is necessary to have a sprocket diameter or sprocket tooth pitch which corresponds and equals the sprocket hole pitch. With this condition fulfilled it will be found that the sprocket will at least theoretically impart uniform film speed, since for the particular wrap in Figure 1, tooth No. 1 will assume that portion of the load previously shared by tooth No. 6. However, it will be found that in practice this ideal condition does not exist. It is common knowledge that film shrinks a certain amount depending upon its age, use, and the treatment it has received. This, of course, would indicate that, in general, no two reels of film have shrunk an equal amount. Therefore, the ideal case shown in Fig. 1 does not exist.

Selecting a Sprocket

In selecting a sprocket to be used as a sound sprocket, it is necessary that its tooth pitch be equal to and correspond to the tooth pitch of new or unshrunk film. If this is done, the tooth pitch will be greater than the sprocket hole pitch when the sprocket is used with shrunken film. While this condition is not ideal, it is the condition under which all feed sprockets operate.

Figure 2 shows a sprocket whose tooth pitch is greater than the sprocket hole pitch. It represents for this discussion a sprocket of proper diameter operating with film which has shrunk by an amount (D) shown in the figure. In operation the film will travel at uniform speed as long as tooth No. 6, which carries the entire load, is engaged. However, the film will slip back a distance (D) on the periphery of the sprocket or run at a reduced speed when the film is stripped from tooth No. 6, thus transferring the load to tooth No. 5. This process repeats itself each time a tooth is stripped or disengaged from the film.

If the tooth shape were a circular involute as shown by the dotted line at tooth No. 6, there would be no slip-back while the film was stripping off the tooth. However, there would be a sudden change in film speed or slip-back the moment the film disengaged with the top of the tooth. While this change in speed cannot be easily determined, it is known to be a rapid and sudden change. It is possible and common practice to change the shape of the tooth from a circular involute curve to one which recedes more rapidly in order to reduce the rapid change in speed which occurs at the period of slip-back.

The tooth shape can be adjusted so that for a given film shrinkage the top of the tooth is a distance (D) from the circular involute curve. By so doing, the film will have slipped back during the stripping period so that when tooth No. 6 disengages, the film will be in contact at tooth No. 5, which will take up the load. Further, the tooth shape may be adjusted so that the slip-back speed will be uniform during the stripping period. Also the tooth shape may be adjusted so that the slip-back speed is low at the beginning and increases as the stripping progresses.

Allows for Maximum Shrinkage

It is to be observed here that the tooth shape, if adjusted for a particular film shrinkage, in accordance with the above discussion, the sprocket will operate as intended only when used with a film having the particular shrinkage considered in the design. If a film having a greater shrinkage is used, the film will be stripped off tooth No. 6 before tooth No. 5 becomes engaged, and will result in a sudden slip-back when the film leaves tooth No. 6. If a film has less shrinkage than that used in the design, tooth No. 5 will become engaged before the stripping is completed on tooth No. 6. Since it is undesirable to have the film slip back suddenly, it is, therefore, customary to adjust the tooth shape for a film having maximum shrinkage so that tooth No. 5 will, for all values of film shrinkages, become engaged before or just at the time stripping is complete on tooth No. 6.

By further reference to Figure 2, it is to be noted the diagram is drawn so the film wrap includes four teeth. The circular involute curve shown by the dotted line at tooth No. 2 indicates that it is possible for the film wrap to include tooth No. 2. However, the circular involute on tooth No. 1 indicates that tooth No. 1 could not be included in the film wrap. If the film wrap were to include tooth No. 1, the lagging edge of the sprocket hole would strike the lagging face of the tooth and would result in non-uniform film speed as well as possible damage to the film in the form of torn sprocket holes. Also, if it were found desirable to include tooth No. 1 in the wrap, this would be possible by decreasing the base thickness of all the teeth to a value equal to the distance from the involute curve at tooth No. 1 to the leading face of the tooth.

It should be further noted that for a given tooth base thickness, the wrap on the sprocket can be increased for

(*Continued on page* 31)

New Equipment and Appliances

New Phonovision 16 mm. Equipment

The Phonovision Company, Inc., with offices at 330 West 42nd street, New York City, announces the development of a new sound on disc, 16 mm. synchronizing system.

The new sound and picture reproducing system is entirely self-contained and compact, being housed in two finely finished soundproof cabinets of special design, so arranged as to be readily portable.

The projector case contains a standard Bell & Howell Filmo projector and a specially designed noise-free synchronizing unit with flexible connecting shaft. The turntable and its attendant pickup are mounted in a separate compartment at the top of the case. When not in use the turntable is easily detachable and mounted on the door on the operating side of the cabinet.

Complete Accessibility

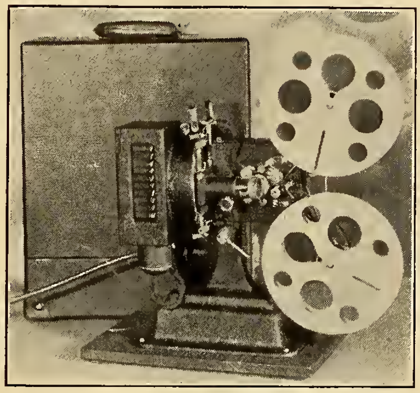
Two doors provide complete accessibility while the projector is in use, and rewinding of the film is accomplished without removing the reels from the projector. The volume and projector controls are so arranged as to be adjustable from the outside of the case. The projection port has been designed so as to make provision for the tilting of the projector, and when closed provides a miniature screen for synchronization before starting the show.

The amplifier and the loudspeaker are mounted in a single cabinet similar in size and appearance to the projector case. The unit comprises a well-made amplifier utilizing the push-pull principle, coupled to a Wright-Decoster speaker of exceptional size. In this case provision is also made for carrying six complete talking pictures. The complete system will give, it is said, excellent quality of reproduction and will furnish sufficient volume for an audience of 1,000.

Victor Offers New Series Model 7 Projectors

VICTOR Animatograph Corporation, Davenport, Iowa, announces that the New Model 7 Victor Ciné Projector is now available in a complete series which embraces the following equipments:

Model 7 Regular, which is equipped with 300 Watt "No Resistance" Lamp (100-120 Volt). Model 7G with 50-60 Cycle A. C. Transformer built into base to permit use of high intensity 250 Watt-20V. Lamp. Current may be diverted from transformer to permit use of 200 and 300 Watt lamps of 100-120 volts on either direct or alternating current. Model 7R with No. 11 Victor variable resistance lamp rheostat mounted with swivel post on projector base. This model accommodates (on either alternating or direct current) the 250W., 50V., 375W., 75V. and 165W., 30V. high intensity lamps, as well as the regular 100-120 volt, 200 watt and 300 watt lamps.



Victor Projector

Better Illumination

Outstanding among the new features offered in the Model 7 Series of Victor Cine-Projectors is an improved optical system which affords much better illumination, regardless of the type of lamp used. The Model 7 Regular, which employs the new 300 watt lamp, is said to set a new standard of illumination for 16mm. projectors that are not equipped with some form of lamp resistance.

The Model 7 Regular and the Model 7G are equipped with the attractive rectangular base which previously was supplied only on the Model 3G. The Model 7R has the pedestal base to permit swinging the rheostat in under the projector body when placing the machine in its carrying case.

Vacuum Contact Switch

A decidedly novel type of switch, featuring sealed-in-vacuum contacts, is introduced at this time by the Burgess Battery Company, New York City. This switch, based on the use of the Burgess vacuum contact actuated by the usual toggle switch movement, is at once flameproof, free from dust and dirt, positive low-resistance, quick-acting and corrosion-proof.

In the new switch the vacuum contact is mounted in a holder held by brackets on the rear face of the switch plate. The throwing of the handle to the closed position serves to actuate the external glass stem of the vacuum contact, either making or breaking the circuit as desired. The vacuum contact is exceptionally sturdy, with a practically unlimited life. It is amply protected by the metal holder. There is no movement of body or leads, and no mechanical wear.

The Burgess vacuum contact switch is rated at 8 amperes intermittently or 6 amperes continuously, 220 volts. The makes and breaks are clean, free from dangerous arcs, and without corrosion. The contact resistance is extraordinarily low.

RCA Equipment in N. Y. Visual Education Program

The first step in the recently announced program to test the potentialities of the sound motion picture as an aid in teaching in the New York public schools was taken January 15 when contracts were signed for the installation of RCA Photophone sound reproducing equipment in the new Samuel Gompers Industrial High School for Boys, 145th Street and Wales Avenue, The Bronx, which is now under construction and which will be open in September. The equipment, one of the recently introduced all AC operated types, will be installed in the assembly room, which will have a seating capacity of 724 persons.

Provisions for the installation of motion picture apparatus having been made when the plans for the new building were drawn, the projection booth and necessary wiring throughout to the loudspeaker apparatus behind the screen will be modern to the most minute detail.

Dr. Eugene A. Collingan, Associate School Superintendent in charge of the visual instruction activities of the New York Board of Education, recently announced that he had suggested experimenting with sound pictures and it is said that other installations will be made in high schools within the next few months.

Dr. Charles Pickett will be principal of the new Samuel Gompers High School, which will have a pupil enrollment cacapity of 1,696 boys. In addition to sound motion picture apparatus, the new school will be equipped with a complete radio communication system with outlets and speakers in all parts of the building. A radio control room will adjoin the principal's desk and through the medium of a microphone the principal will be able to speak to one or all rooms or even to students upon the outdoor courts. Seventy-six loudspeakers will be located at various points of vantage.

Patents:

A series of instructive and interesting articles on how patents are obtained and sold.

By Ray B. Whitman

Note: *In this series of articles Mr. Ray B. Whitman, practicing patent attorney of New York City, explains in understandable non-technical language just what a patent is, how one is secured and how it may be sold. In addition, Mr. Whitman offers to the readers of this magazine personal advice without obligation on any subject connected with patents, trademarks, designs, or copyrights. All inquiries should be addressed to Mr. Whitman in care of this magazine.*—Editor.

The Working Model

DON'T have anything about the model you are demonstrating which requires any excuse. The prospective purchaser is often so overcautious that he will fix upon some slight flaw in the device and actually "make a mountain out of a molehill," and the sale will be lost.

It costs money to make working models. If the inventor is not able to finance these himself, he should find some friend who will take a small interest in the proceeds from the sale of the patent (not an interest in the patent title itself, *which ought never to be given*), in return for enough money to have a good working sample made. This work had better be left to some experienced model-maker or expert mechanic, for home-made models rarely sell inventions.

Fourth: Plan a definite selling campaign, and then follow it to a finish.

Trying to sell a patent by making a few individual efforts is almost sure to fail. Any method employing the "Law of Averages" is the one to follow, for this marvelous law is a pretty good one to have working for you. Thus, many attempts at a sale should be made simultaneously, with as many prospects.

This prevents the sale of the patent from dragging unduly, and becoming known as "for sale" over a long period, which is almost sure to give it eventually a bad reputation, regardless of its inherent worth. These efforts at a sale should be made, whenever possible, before the issue of the patent, but after a substantial number of claims have been allowed.

Classified Advertisements

All interviews should be made only by invitation, obtained usually through correspondence. For the methods of "cold-canvass" are absolutely taboo in the selling of a patent. The best way to begin is to get first a number of really good prospects. This can be done by placing classified advertisements in the "Business Opportunities" section of the big metropolitan newspapers, such as The New York *Times* and The Chicago *Tribune;* similar ads, or even the more costly display ads, may also be run in the proper trade magazines.

Here is a sample classified "ad" which proved successful in getting many good prospects, and which finally sold the patent:

Valuable New United States Patent on office device seeks buyer, promoter, or salesman; successfully sold in Canada; easy terms. Z 2186 Times Annex.

Another method of finding buyers is to get the addresses of a score or more manufacturers of products similar to the invention. These can be obtained from an industrial register in the library. Or better, have your patent attorney get from the Official Patent Office Gazette the names of manufacturers who have recently had patents assigned to them in the same class and sub-class. To each an introductory sales letter is typewritten, explaining the merits of the invention, its character, and exactly what it may be expected to accomplish for the particular manufacturer, the thought being constant during the writing of this letter to appeal to his pocketbook.

When the inventor calls to see a prospect, he should have with him, if possible, his perfected working sample, and be able to demonstrate it efficiently. When leaving, it is usually best not to leave the model, as often "familiarity breeds contempt," and an unskilled handling of it is sometimes apt to develop its minor weaknesses. Furthermore, the results of a successful demonstration are usually remembered by the prospect in an optimistic way, and it is usually safer not to let him brood over the model and discourage himself. Of course this is all general advice, and circumstances alter cases.

Handling the Prospect

If the prospect is interested and asks questions about the patent rights or the selling price, the owner should simply say, as to the latter, that he has no set ideas about the price, but feels sure that something satisfactory can be arranged. And he should say, as to the patent rights, that he will have his attorney submit copies of the applications or patents as well as the loan of a certified copy of each file history, so that the buyer's attorney may determine the validity and scope of the claims.

Testimonials, reports of tests, and similar data may also be used to advantage at this point.

Fifth: After getting a good prospect, bring him to your counsel to close the deal.

When the inventor has obtained a really interested prospect, he should then adroitly manœuvre to introduce him to his attorney; preferably by having the prospect call, for that puts the attorney in the best position to negotiate. But when this cannot be done, the attorney then arranges the appointment and completes the negotiations.

Closing the Deal

An attorney who has had a successful experience in patent contracts and their negotiations is best able to induce the prospect to become a purchaser, licensee, or financial backer. If the inventor attempts to close the deal himself, he is often seriously handicapped through a lack of the knowledge and skill possessed by the manufacturer or his representative. Also, the question of terms and the nature of the contract can best be settled with the help of counsel, and various other points raised by the prospect at this juncture and which may spoil the sale, can often be overcome by adroit handling, a shrewd ability to compromise, or in an indirect or obscure manner.

Sixth: Have a clear idea of the kind of arrangement you want, and point your efforts toward getting it.

What kind of contract is best?

The best contract for both the seller and the buyer is usually an exclusive license agreement given to the buyer by the seller, who thus still retains the title to his patent. An outright assignment is often much more difficult to sell because it involves the purchaser in greater financial risk, and it seldom makes the inventor as much money as the royalty license agreement.

Character of Agreement

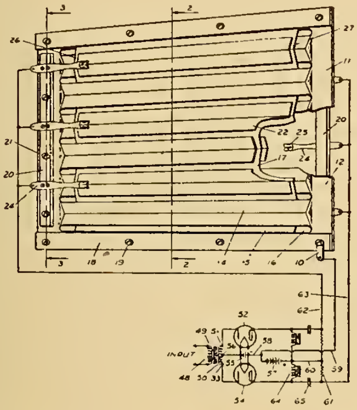
This agreement is usually an exclusive transferable license to make, use and sell the invention during a definite period of years, not exceeding the patent term, on the basis of a definite sum as royalty for each article manufactured, a reasonable down payment as "earnest money" to prevent the licensee tying up the inventor and then not doing anything with his invention, and finally, *with a minimum guarantee clause*, by which the contract is revocable at the option of the inventor, and without prejudice to his rights otherwise, in the event the licensee does not make enough of the product to give the inventor a reasonable royalty return. Other important provisions are also included to protect properly both parties against the more common contingencies.

Too much thought and skill cannot be given to preparing such contracts, for on them often depends the inven-

RECENT PATENTS

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 230 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine, and enclosing fifteen cents to cover costs.

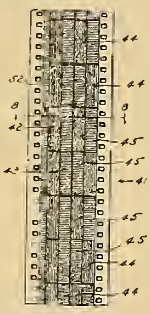
1,831,278. ELECTROSTATIC SOUND TRANSLATOR. LAYTON ALLEN WOLFE, San Diego, Calif. Filed May 29, 1930. Serial No. 457,063. 23 Claims. (Cl. 179—111.)



1. A sound translator comprising in combination a plurality of fixed electrical conducting elements, a dielectric diaphragm positioned with portions thereof adjacent to the said elements, the dielectric having isolated conducting bodies thereon, each conducting body being adjacent to one of the elements, and means to electrically energize each element and its adjacent conducting body to different electrical potentials.

▲

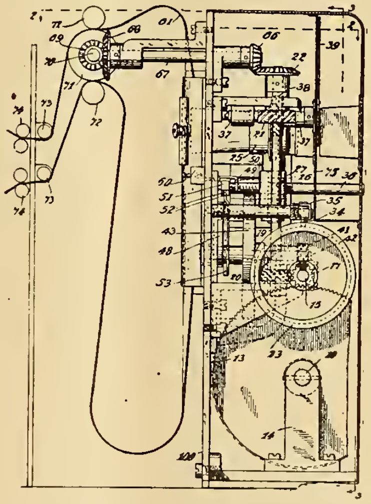
1,830,468. COLOR-PHOTOGRAPHY. WILLIAM V. D. KELLEY, Los Angeles, Calif. Filed Nov. 12, 1929. Serial No. 406,624. 5 Claims. (Cl. 88—16.4.)



2. The method of color-photography which consists in making a pair of color selection negatives of a colored selection negative of a colored object, of which one is minus the red values and the other is minus the blue-green values; making a series of positives on a motion picture film by printing said negatives; superposing upon alternate frames of said series, prints made from a positive print of the red-selection negative, wherein the silver has been eliminated, its place taken by a colored dye, and the remaining portions are toned a complementary color; and superposing upon the other frames of said series, prints made from the blue-green negative, wherein the silver has been similarly eliminated and the emulsion colored; whereby, upon the projection of said film, an image of said object in its natural colors will appear upon the screen, the uncolored portions of said image being due to the additive effect of the complementary colors in corresponding areas of alternate frames of the film.

▲

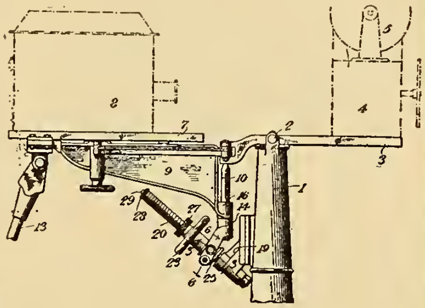
1,837,467. MOTION PICTURE CAMERA. WALTER J. McINNIS, Stelton, N. J., assignor to Widescope Camera Company, Newark, N. J., a Corporation of New Jersey. Filed Oct. 4, 1924. Serial No. 741,629. 13 Claims. (Cl. 88—16.)



1. In a motion picture camera, in combination, a lens capable of horizontal oscillating movement upon its focal center, means for oscillating the lens in a horizontal plane, means for intermittently feeding a film in a vertical direction, means for curving the film in a vertical direction with the concave face toward the lens, and means for focusing the lens during its oscillating movement.

▲

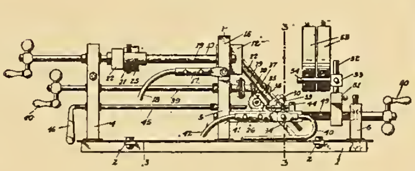
1,838,750. MOTION PICTURE PROJECTOR ADJUSTING AND LOCKING MECHANISM. AUGUSTO DINA, Jersey City, N. J., assignor to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed Feb. 15, 1928. Serial No. 254,433. 6 Claims. (Cl. 248—47.)



2. In a picture projection machine, a pedestal an elongated member secured thereto, an adjusting member having pivotal relation to said pedestal and to said elongated member an adjusting element adapted to move along said elongated member, a cross member constrained to move axially with said element but free to move transversely thereof, said adjusting member being pivoted to said cross member.

▲

1,838,170. PROJECTION LAMP. GEORGE ARANO, Modesto, Calif., assignor of one-half to Robert R. Fowler, Modesto, Calif. Filed May 28, 1928. Serial No. 280,977. 5 Claims. (Cl. 176—65.)



2. In a projection lamp, a horizontal positive carbon, a negative carbon facing and disposed at an angle to the positive carbon, a rigid block extending transversely of the negative carbon, transversely spaced guide members secured to and projecting from the block toward the positive carbon in parallel relation to the negative carbon a block slidably supported by said members and on which the negative carbon is clamped, means applied to said last named block for advancing the same along the guides and means for shifting the first named block transversely.

tor's entire chance of a profit from his invention.

Outright Assignment Losses

Inventors frequently lose an opportunity to make money out of their patents by being too hasty in the beginning in signing away a part of their rights, particularly through outright assignment.

The vital fact in this connection that is seldom understood by laymen, is that the outright assignment of any portion of a patent right, no matter how small, puts the assignee of that right in possession of a right to *license under his right* as fully and completely as can the inventor, even though he retains the major portion of the patent right. To illustrate, an inventor may assign an undivided one-tenth interest in his patent. He then often thinks that what he has left is nine times more valuable than what he assigned. But this is not the case, since the person getting the one-tenth interest, or, in fact, any other undivided part, obtains *exactly the same right to license others* to the use of the invention as has the owner of the remaining rights.

It is wise never to sell an undivided interest in a patent, but only either an outright assignment or a license to use it. This last preserves the title in the inventor, the sole right to sue for infringement, and also the exclusive right to sell additional licenses.

Always Consult Attorney

Right here it is well to sound a warning against signing any paper whatsoever regarding your patent without first submitting it to your attorney. And try always to arrange to let him draw up any license or assignment. For only the able patent attorney with practical experience in such contracts can properly protect your interests.

A patent contract is unlike all others. Its laws are filled with technicalities little known to the general lawyer. Just to cite one instance: an assignment of "*the* entire right" to a patent, compares with one of "*my* entire right," exactly the same as a warranty deed to real estate does to a quit-claim deed.

So if you are the buyer of a patent, your attorney will see that you get "*the* entire right." And if you are the seller of it, he won't let you get into the difficulty of one inventor known to the author, who, instead of assigning "*my* entire right, etc." found afterwards that he had given "*the*" right, although he had previously granted a shop license under the same patent to others; and the purchaser held him to his warranty, forcing him to return a substantial part of the purchase price in lieu of a settlement.

One method often used with great success to make money from a patented invention, is through the incorporation of a company and the transfer to it of the patent rights in return for a stock interest. The company then undertakes the manufacture and sale of the invention. This method enables the inventor to get into a profitable business as a result of his inventive genius.

The first step is to get your attorney's advice on the details of the incorporation, such as the best state to incorporate in, the amount of capitalization needed, whom to name as incorporators, the amount and kind of stock to issue, and the avowed purpose of the corporation.

He will also help you decide on a name for the new company, and have a search made in the state's capitol to be sure that the name is free to use. He then prepares the charter and other incorporation papers, and sees that they are properly filed with the Secretary of the state, and the taxes paid.

Because of low annual fees and other attractive features of their incorporation laws, certain states are more popular than others with incorporators. For instance, the states of Delaware and West Virginia are used by many concerns whose principal places of business are elsewhere.

Since the cost of incorporating in either of these states is appreciably less than in many others, if initial expense is of great importance, it might be well to consider one of them for the location of your home office. But unless there is some such specific reason for doing so, it is usually well to incorporate in the state of residence, as such action creates confidence on the part of your friends and acquaintances who may be possible investors of the stock of the new company.

Preparing the Prospectus

Before proceeding to exploit the sale of the stock, it is necessary to prepare an attractively worded prospectus of the proposition, giving not only facts about the corporation and its personnel, but detailed information on the merits of the invention, the strength of the patent protection, the advantages claimed over existing articles or methods in the same field, a comparison of costs with that of competition, the sources of possible income to make the corporation produce profits, and a statement as to the purpose for selling the stock.

From this point on, the work of raising working capital is largely a matter of pure sales ability. For the proposition is now in business-like form, and prospective investors have the necessary information to judge the attractiveness of the issue, and through the stock certificates a convenient means of obtaining a definite part of the business in return for the money invested.

Of course, it is not always a simple matter to sell stock in such new ventures, for while they may present at-

STILL PREFERRED

Above All Others

MORE Miehling books have been sold to projectionists than any other . . . . There have been others since Miehling's book was brought out . . . . and some at a lower price . . . . but Miehling's still remains as the *only book written by a projectionist for projectionists* . . . . That it why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of *all* sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.

519 pages . . . completely indexed

THIRTY-ONE chapters, each covering a phase of sound equipment operation, are thoroughly indexed in the back of the book, affording the projectionist full means of reference in case of trouble. The whole set-up of the book has been designed for leisurely reading or for quick use in a breakdown emergency.

ONE hundred and thirty-seven illustrations: diagrams, schematic drawings and photographs are scattered through the book, adjacent to connecting text. Continuity of text and picture is thus preserved throughout. A perfect book for projectionists.

Price $4.00, We Pay Postage

Mancall Publishing Corp.,
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $4.00.

Name ....
Address ....
City and State ....
Position ....
Theatre ....

tractive speculative possibilities in the mind of the investors, the mortality rate of such new corporations is known from statistics to be so great that the experienced are prone not to take a chance, and instead to limit their investments to established businesses with a record of past earnings.

Nevertheless, skilled salesmanship will often succeed in raising money by this means, particularly if it is possible to follow the advice offered recently by one of the best known financial brokers in the country. He stated that when all other methods fail, he could always depend upon floating a new company successfully by locating it in a small community anxious to get new business, and getting a free factory site and the cooperation of the local Chamber of Commerce in selling the stock locally, through the argument that the success of the new enterprise meant more business for the local merchants, jobs for the townspeople, and perhaps the bringing in of new workers, with a resulting increase in property values.

In Conclusion

In the conception of a valuable patentable invention, in obtaining a strong patent to protect it, and finally in making money out of the patent,—whether in the capacity of inventor, manufacturer, or investor — the quality of *persistence* plays an all-important part. It is therefore fitting to close this little treatise with the sage advice of Mr. Edison, our greatest inventor:

"I believe that any person, even of the most limited capacity, could become a successful inventor by sheer hard work. You can do almost anything if you keep at it long enough. The constant brooding on the one thing is sure to develop new ideas concerning it, and these in turn suggest others, and soon the completed idea stands out before you. Above all things a man must not give up, once he has outlined his plan of action. A ball rolling down hill is sure to reach the bottom ultimately, no matter how many obstacles stand in the way. It is this principle which finally levels mountains. So, once fairly on your way, don't stop because of some seemingly impassable object in front of you. What you want may be just beyond your nose, though you do not see it."

The End

QUESTIONS AND ANSWERS

Q. 1—Please advise if there is any way to protect my invention from someone getting ahead of me to the Patent Office while I am still experimenting on it. I am told by a local attorney about a paper called a Caveat which can be prepared and signed, and which is much less expensive than filing an extra patent application.

A. 1—There is no way to prevent someone getting ahead of you to the Patent Office with an application for a patent on an invention without filing your application first. The law of Caveat was repealed July 1, 1910. It provided for an inventor giving notice to the Patent Office of incomplete inventions by a signed paper called a Caveat which explained the purpose of the invention or discovery and its distinguishing characteristics and asked protection of the inventor's rights until he should have matured his invention. It was required to be filed in the confidential archives of the office and to be kept in secrecy and it had to be removed from year to year to keep it enforced. The person filing it was entitled to be notified of any application for a patent made during the lifetime of the Caveat, which application, if granted, would interfere with the invention claimed therein, and was entitled to priority by reason thereof.

The next best thing to do in the absence of your ability to file the application as soon as possible is to prepare a description and sketch of your

VALLEN proscenium equipment is designed to enable the projectionists to correlate its operation with the projection equipment, thus enhancing the artfulness and glamour of the presentation.

Detailed information on request.

VALLEN ELECTRICAL CO., Inc.
AKRON, OHIO

VALLEN
PRODUCTS

Noiseless All-Steel Safety Track, Noiseless Curved Track, Aero-Speed Control, High Speed Curtain Control, Junior Curtain Control, Automatic Screen Modifier, Adjustable Volume Ventilating Fan, Electrical Awning Operator.

DARES TO GUARANTEE

CLARITY
CONSTANCY
RUGGEDNESS
UNIFORMITY

All these paramount qualities are inherent to TELE-PHOTO PHOTO ELECTRIC CELLS.

The price and quality are right. Made in all types Caesium-Argon.

Get one of our new booklets. Some extremely interesting data for you.

Telephoto & Television Corp.
133-135 West 19th Street, New York City

Carbon Prices Reduced

EFFECTIVE January 1, 1932, substantial price reductions apply to all National Projector Carbons.

Motion Picture Theatres will save from five to twenty-eight per cent on their carbon costs at these new prices.

This announcement is in line with National Carbon Company's policy of sharing with the industry benefits derived from its program of intensive research and steady improvement in manufacturing methods.

Use National Projector Carbons in your theatre.

A sound investment in 1931.
A better investment in 1932.

NATIONAL
PROJECTOR CARBONS

. . . Sold exclusively through distributors and dealers. National Carbon Company will gladly cooperate with the producer, exhibitor, machine manufacturer or projectionist on any problem involving light.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division · Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation

BRANCH SALES OFFICES: NEW YORK PITTSBURGH CHICAGO SAN FRANCISCO

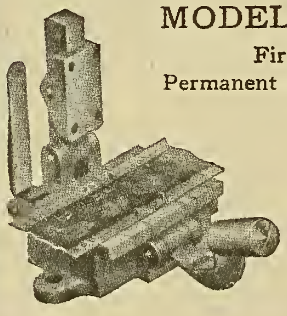
HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

H&C INC.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.



Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film
Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.

For sale by all Supply Dealers

TALKING PICTURES

By Bernard Brown

A detailed discussion of the principles of construction and operation of sound film apparatus including a complete history of its development. Of great importance is the full account of R.C.A. power system and the Western Electric speaker unit. Specially valuable for operators, technicians, and also the general reader. Many illustrations and charts. $3.00.

TELEVISION—TODAY and TOMORROW

By Sydney A. Moseley and H. J. Barton-Chapple. $2.50.

Write for descriptive lists

ISAAC PITMAN & SONS, 2 West 45th Street, New York

invention known as an "Evidence of Conception" and sign and date it before a notary and retain such papers in the event of an interference proceeding later. This might prove priority of conception and entitle you to the patent over a claimant.

Q. 2—I have just been to Washington and admired the Grecian architecture of our Patent Office Building. Please let me know how old it is.

A. 2—The present building was built and has been occupied since about 1840. Prior to that time the Patent Department was first in Blodgett's Hotel on E street between Seventh and Eighth. This building was purchased in 1810 and occupied by the Patent Office and the Post Office until it burned, December 15, 1836, destroying seven thousand models. It was the only public building not burned by the British in 1814.

Patent Interference

Q. 3—What is a patent interference proceeding?

A. 3—An interference is a proceeding between two or more claimants for a patent to the same invention to determine which of them is entitled to the patent. These proceedings are highly technical in character and their necessity arises through the simultaneous working of more than one inventor in the same field. Because every invention is a gradual evolution due to what has been invented before, and also to public need of a new article, it often happens that two or more inventors working independently bring out the same idea at the same time. This brings on the proceeding known as an "interference." Alexander Graham Bell was only a few hours ahead of Elisha Gray in recording his invention of the telephone and the question of the right to a monopoly on the patent was long in interference. Three inventors invented photography in 1839, and two besides Edison claimed invention of the phonograph in 1877. There were two rival claimants for the typewriter as well as for the stereoscope. In more recent years long-drawn-out contests had first to be decided to determine the first inventor of patents for the gas engine between Daimler and Seldon. It was largely by the proceeding known as an interference together with its attendant litigation later that these competing rights were finally determined.

Q. 4—Can a patent be invalid before it has been tested in court?

A. 4—No. All patents are prima facie valid until proven otherwise. The grant of the patent carries with it the presumption of its validity and this is so strong that the burden of proof upon a defendant to establish the defenses that attack the validity of the patent is the same as that upon the prosecution in a criminal case.

Q. 5—Is there any way to prevent immediately the infringement of a patent which has not been adjudicated in Court, by getting a preliminary injunction pending the outcome of a suit?

A. 5—It is the common practice of the courts not to grant a preliminary injunction except on an adjudicated patent and it often proves difficult to have an exception made of this rule. One exception to this, however, is the case of patents which have run for many years and their validity has been acquiesced in by the public as evidenced, for instance, by the taking out of many licenses.

Theory and Fundamentals

(*Continued from page* 24)

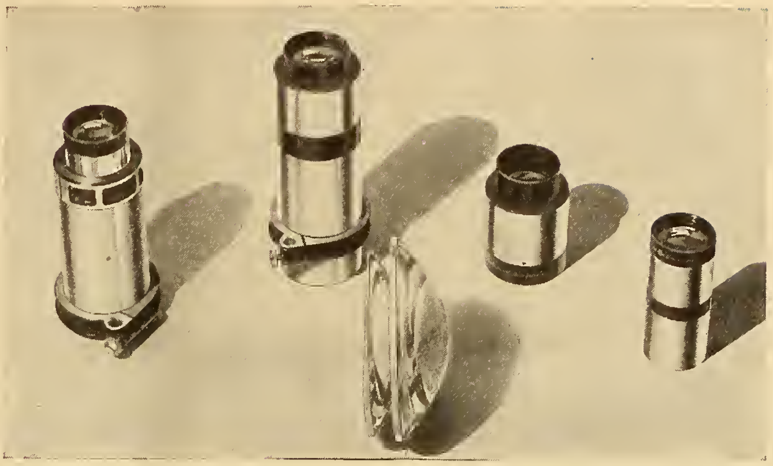
films having less shrinkage, and should be decreased for films of greater shrinkage. If in operation the lagging edge of sprocket holes are found to be torn, further damage can oftentimes be prevented by reducing the film wrap. The tooth base thickness is usually reduced to a value which will operate properly taking into account the maximum film wrap and the maximum film shrinkage expected.

An Opposite Condition

In the preceding discussion we have been concerned primarily with those cases in which the sprocket hole pitch is equal to or less than the tooth pitch. Figure 3 shows the case in which the sprocket hole pitch is greater than the tooth pitch. Obviously this condition could not exist unless a sprocket of too small a diameter is used, because film never stretches with use but always shrinks. The sketch has purposely been drawn to include only two teeth in the wrap. Tooth No. 4 is shown engaged. The leading edge of the sprocket hole is shown buckled at tooth No. 3.

The amount of buckling depends upon the difference in pitches (D), and the amount of film damage, and sound distortion will also depend upon the difference in pitches. If tooth No. 2 were to be included in the wrap, the film would strike the leading edge of the tooth, and the buckling would be twice as great as for tooth No. 3. Likewise, the film would strike still further up on the face of tooth No. 1, and the buckling would be three times that for tooth No. 3. If leading the edge of sprocket holes are found torn by a feed sprocket, it is fairly certain that the sprocket diameter is too small.

In summarizing it may be pointed out that for any feed sprocket, first, the ideal sprocket is one which has a tooth pitch equal to the film pitch (a condition which seldom exists), second, sprockets having a tooth pitch greater than the sprocket hole pitch (within limits) do operate and can be made to operate properly by properly adjusting the shape of the teeth, and third, sprockets having a tooth pitch smaller than the sprocket hole pitch cannot be made to operate with-



Super Cinephor Improves the Show From Any Seat in the House!

THE new Super Cinephor gives the sharper definition and higher screen brilliance that make every screen showing more satisfactory . . . from any seat in the house.

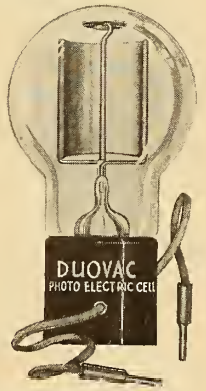
Available *in focal lengths down to 2 inches,* Super Cinephor produces a clear cut image right to the margin of *either* standard or large screens. It throws an image that's in true critical focus, and the field is as flat as your screen.

Super Cinephor is the first true anastigmat . . . fully corrected for Spherical and Chromatic aberration, and with the new B & L Condensing System it transmits to the screen 50 to 100 percent more light . . . giving a clarity and brilliance that any patron can, and will appreciate.

See your supply man right away and try a Super Cinephor. If you write, Catalog E-16 gives all details.

BAUSCH & LOMB
OPTICAL CO.
680 St. Paul Street
Rochester N. Y.

BAUSCH & LOMB



· PHOTO-ELECTRIC CELLS · · ·

(CAESIUM ARGON TYPE)

DUOVAC's most recent contribution to the science of better Sound Projection. A new Photo electric cell of the caesium argon type. Guaranteed longer life, unaffected by heat through continuous usage and offers a new degree of tone fidelity—the result of Duovac painstaking research. Guaranteed, non-michrophonic.

There is a DUOVAC TUBE for every projection requirement.

Complete tube equipment now available for the following sound systems: WESTERN ELECTRIC, R. C. A. PHOTOPHONE, De FOREST PHONOFILM, PACENT, and every other standard make.

Write for descriptive folder illustrating the new 242, Power Amp. 264A, designed to replace the 239A, and the 205D. Also other tubes for all sound systems.

For particulars write

DUOVAC RADIO TUBE CORP., 360 Furman St., Brooklyn, N. Y.

Guaranteed! **BETTER SOUND—*Lesser Cost***

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

Rheostat leadership may be claimed by many, but we have it—

"Perfection" in name and performance.

Motion picture theatre owners and projectionists from Maine to California endorse our claim and know it's no idle boast.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Specialists

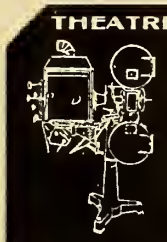
RHEOSTATS

INSURE YOUR JOB!
Study F. H. Richardson's
Handbook of Projection

Three volumes containing over 1,400 pages of vital knowledge with question and answer index. Every projectionist needs this authoritative guide. See your local theatre dealer or send for full details.

CHALMERS PUB. CO.
516 Fifth Ave., N. Y.

THEATRE EQUIPMENT
NEW AND USED



Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.

Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.

We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.

Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO., 844 So. Wabash, Chicago

Give This to Your Friend—Have Him Fill It in and Mail to us at Once

The Motion Picture Projectionist
7 West 44th Street, New York City

Gentlemen:

Enclosed please find $2.00 for which enter my subscription for one year (12 issues) starting with..............................issue. (Two years, $3.00.)

Add 50 cents for Canadian postage; $1.00 for foreign.

Name ....

Street ....State ....

City ....Local No. ....

out variation in film speed or damage to the film.

This article on the subject of sprockets will be continued in the March issue with a discussion of hold-back sprockets.

Marine Talkies Go Democratic

Sound motion pictures will provide entertainment for passengers aboard the new Matson Line S.S. *Mariposa*, which sailed upon its initial trip from New York to Australia recently.

Two complete units of RCA Photophone sound reproducing equipment have been installed in specially built projection booths adjoining the first and second cabin lounges and a program will be presented each evening during the trip.

The Matson Liners *"Monterey"* and *"Lurline,"* both now under construction, will be similarly equipped. The three vessels, to cost approximately $25,000,000 when all are completed, will be the first ocean-going liners to install permanent sound reproducing equipment for the entertainment of both first and second cabin tourists.

SRA Carbons Now in Great Demand

The use of National SRA carbons in the many theatres employing low intensity reflecting arcs is proving highly successful in meeting the demands of a higher level of screen illumination necessitated by the introduction of sound, color and a larger screen image, it is announced by the National Carbon Company.

It is the claim of the manufacturers that SRA carbons permit a substantial increase in arc current and provide an intense crater brilliancy. This crater light is focused on the projector aperture in a field of even intensity. A liberal latitude in positive crater position provides the assurance of uniform illumination of the screen.

Effective on January 1, 1932, the company announced substantial price reductions, applying to all National Projector Carbons. This announcement, it is said, is in line with the firm's policy of sharing with the industry the benefits of intensive research and improvement.

Local 329 to Entertain

The annual banquet and entertainment of Local Union 329, Motion Picture Machine Operators, of Scranton, Pa., of the I. A. T. S. E. of the United States and Canada, will be held in the Crystal Ballroom of the Hotel Casey in Scranton, Pa., on Sunday evening, Feb. 7.

Among those present will be members of the State Board of Labor, industry officials from Harrisburg and International Alliance officers from New York City. It is expected that about five hundred persons connected with the motion picture industry will attend the affair.

Local 306 Re-elects Kaplan

Sam Kaplan has been re-elected President of Moving Picture Machine Operators' Union, Local 306, for a term of four years by the unprecedented majority of 527 votes. The election was strictly supervised by officials of other labor unions, who were delegated to this task by the American Federation of Labor.

Nearly the entire membership of the union turned out for this election. A record-breaking vote of 1,160 ballots was cast, out of a total membership of 1,202, of which Sam Kaplan received 841 votes and Charles Beckman, the candidate of the opposition, 314 votes.

In order that the election might be absolutely fair, Mr. Kaplan requested that a Committee of Union Officials not connected in any way with Local 306 be appointed to conduct and supervise the entire election. For this purpose the following men were appointed by the American Federation of Labor: Bruno Wagner, of the Brotherhood of Painters, Local 499; Edward P. Clark, of New York Typographical Union, Local No. 6; Leonard C. Kaye, President of the New York Press Assistants' Union, Local No. 23, and Morris Feinstone, Secretary of the United Hebrew Trades.

Other supervisors of the election were: Louis Schaefer, Labor Editor of the Jewish Daily Forward, and I. Roesner, Secretary of the League for Industrial Democracy, and personal representative of Norman Thomas.

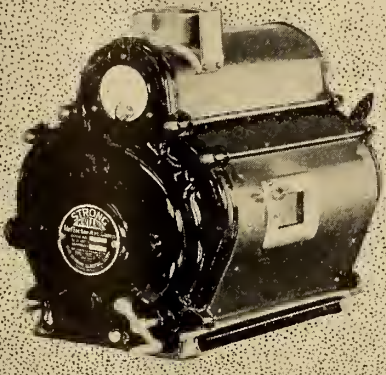
The election was conducted strictly in accordance with the Australian ballot system, and the voting was absolutely secret.

The balance of the ticket elected with Sam Kaplan comprise Vice-President, Charles F. Eichhorn; Recording Secretary, I. R. Cohn; Financial Secretary, D. Engel; Treasurer, M. Feinberg; Sergeant-at-Arms, P. Ciambrelli. Trustees—as follows: B. A. Friedman, M. Kravitz, M. Pall. Executive Board: C. Bayer, M. J. Rotker, H. Greenberg, M. Sternberg, F. Lachmann, E. T. Stewart, H. Luck, Wm. Weiss, Wm. Pastner, J. S. Winick.

Following the election, Mr. Kaplan took occasion in thanking the members for their support to read a statement signed by the defeated candidates and the outside supervisors that the election had been fairly conducted and that the count was accurate.

S.M.P.E. Spring Meeting to Be in Washington

The Society of Motion Picture Engineers will hold its Spring Meeting in Washington, D. C., May 9-12, according to an announcement made by the Board of Governors of the Society. Washington was selected by the Board of Governors following a majority vote for this city by the membership.



The Trouble Spot Eliminated In Portable Projection

STRONG PORTABLE TYPE REFLECTOR ARC LAMP

Designed for projection of 35 or 16 mm. film. Especially valuable with sound equipment, giving a brilliantly illuminated picture as large as 8 to 12 feet wide, even on porous screens.

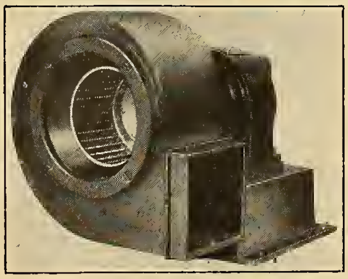
Operates from any lamp socket with current from 8 to 16 amps.

Weighs less than 25 pounds. Size 18" x 12" x 10". Extremely simple in operation.

A new rectifier unit as companion to this lamp is also available.

For sale by Independent supply dealers

The Strong Electric Corporation
2501 Lagrange St., Toledo, Ohio
Export Offices: 44 Whitehall St., New York, N. Y.

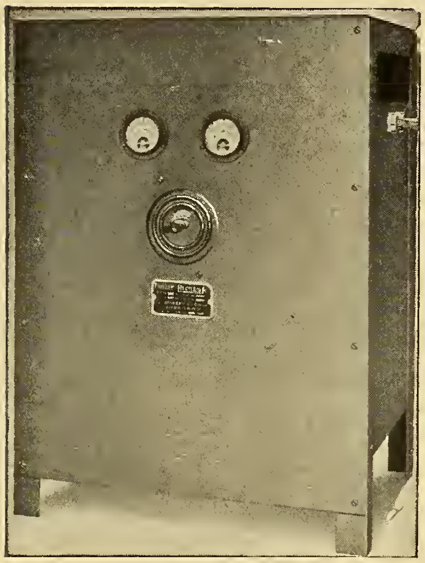


Good Ventilation means *Long Life* to Machines and Men too

Our Booklet shows how to install. Write now for new Low Prices.

TYPHOON AIR CONDITIONING CO.
233 West 42nd Street, New York City
Phone Wisconsin 7-1296

Good Projection Requires Good Rectification



M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes, then the other two, as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP.
New and Wilsey Sts.
Newark New Jersey

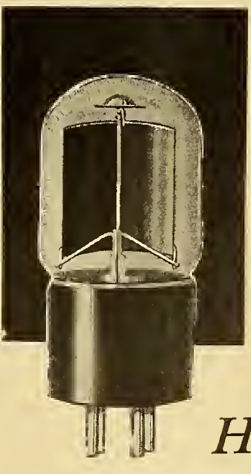
Foreign Experimenters Work on Cellophane Film Development

American producers are manifesting considerable interest in the report that film companies abroad are experimenting with cellophane as a substitute for regular film stock. Interests in this country, it is said, have already started an investigation to determine what progress has been made toward perfecting the process.

According to information available at the present time, attempts to use cellophane have not been successful and much research will be required before substitution can be considered practicable. The official report runs as follows:

"The image on this film is not obtained from a silver emulsion, but from the action of light and a combination of dyestuffs. After printing, which requires a very intense light, and even then is rather slow, the film is developed with ammonia gas or some related compound. The final image, purely a dye image, has not, according to our information, approached in photographic quality that obtainable from the regular silver emulsion type of film.

"In some demonstrations which have been given in Europe, a great deal of trouble has been encountered in keeping the image from floating up and down on the screen during the course of projection."



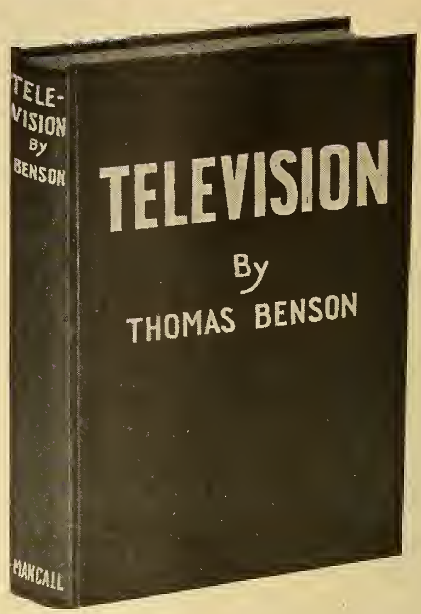
HIGH SENSITIVITY

is a prime feature of Visitron Photo-electric Cells . . . . . . which means brilliant sound reproduction. A comparison with ordinary cells will prove it. Ask the National Theatre Supply Company salesman.

G-M LABORATORIES INC
1733 Belmont Avenue Chicago, Ill.

PHOTOELECTRIC CELLS
VISITRON
REG. TRADE MARK

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today. It is a book both for the interested layman and for the craftsman who will shortly depend on television operation for his livelihood. It has been written especially for the motion picture projectionist who will unquestionably operate television in the theatre as he now does sound equipment. The serious projectionist will get a copy at once.

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

TELEVISION
By Benson $2.00

SEND THIS COUPON TODAY
Mancall Publishing Corp.,
7 West 44th Street, New York City
Enclosed find money order for $2.00.
Please send me Benson's Television.

Name ....

Address ....

City and State..............................

Theatre ....

Easy to Get—

but *Mighty Hard to Get Along Without . . .*

National Service has created a new idea of what projection men have a right to expect from an equipment and supply house. Intelligent, speedy, always dependable attention to the mechanical needs of the projection room has convinced our customers and friends that, while National Service is easy to get, it would be mighty hard to get along without it.

TRADE WHERE
YOU'RE ALWAYS
TREATED RIGHT

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

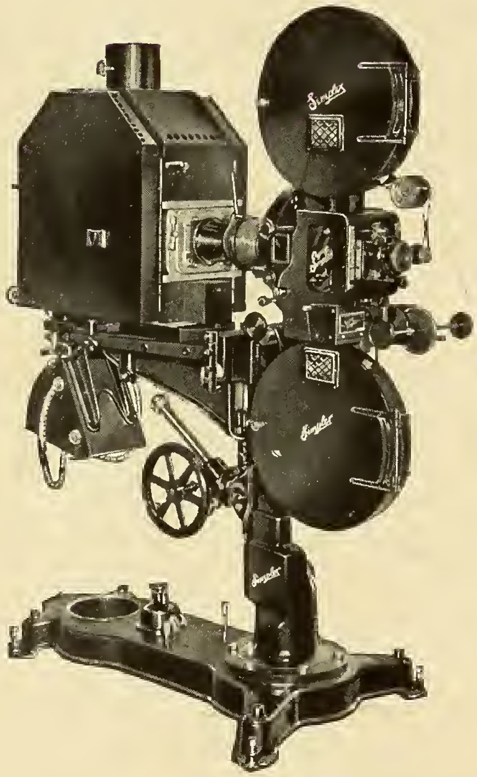
REPLACE WITH Simplex PROJECTORS
TRADE MARK REG'D.

OWNERS WHO ARE SHOWMEN
—MANAGERS WHO MANAGE—

KNOW THAT

BETTER PROJECTION PAYS

PAYS IN THE INCREASED PLEASURE OF THE PATRON
PAYS IN THE INCREASED BOX OFFICE RECEIPTS



Simplex
The International Projector

Simplex
TRADE MARK REG'D.

THE INTERNATIONAL PROJECTOR
Creates and Maintains World Projector Standards

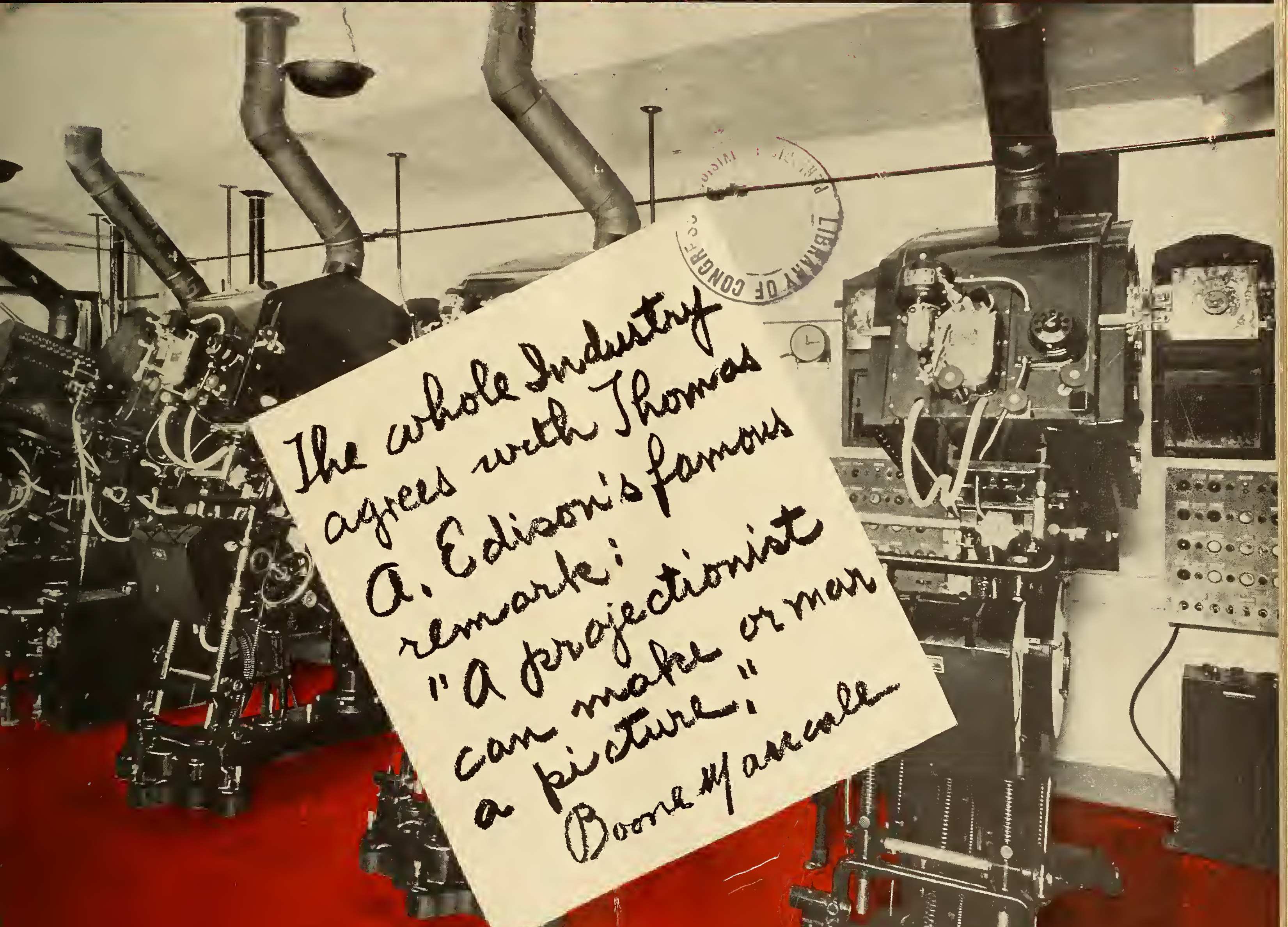
—High Projection Standards Are Essential
Poor Projection Mars the Pleasure of the Patron
Theatres That Pay Are Managed by Men Who Have Learned "Neglect Is Poor Economy"

REPAIR WITH GENUINE Simplex PARTS
REPLACE WITH Simplex PROJECTORS

INTERNATIONAL PROJECTOR CORPORATION
90 GOLD STREET NEW YORK

REPAIR WITH GENUINE Simplex PARTS
TRADE MARK REG'D.

MOTION PICTURE PROJECTIONIST



The whole Industry agrees with Thomas A. Edison's famous remark: "A projectionist can make or mar a picture."
Boone Mancall

LIBRARY OF CONGRESS

Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.*
Editorial and Advertising Offices, 7 West 44th Street, New York City.
Entered at New York Post Office as second class matter, October 25, 1927.

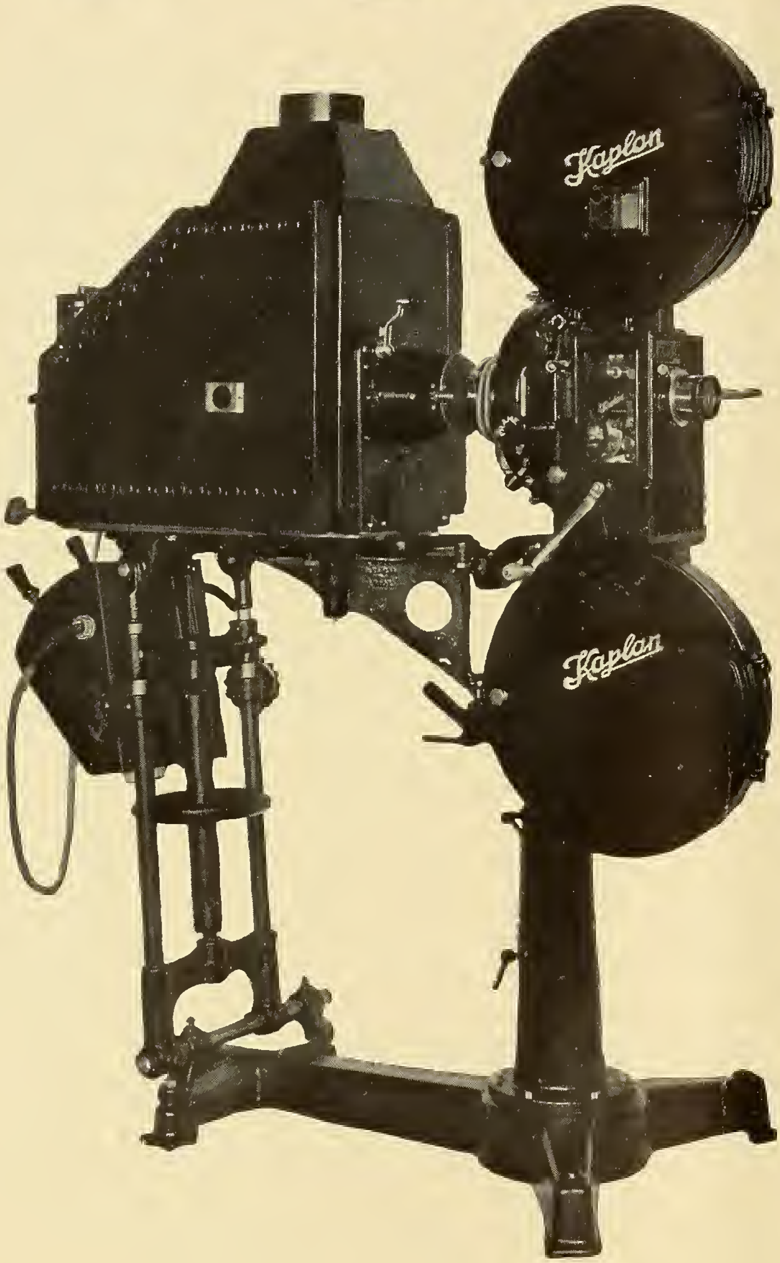
Vol. 5 • No. 5
25c per copy $2 per year

March, 1932

FIFTH YEAR OF PUBLICATION

Kaplan

PROJECTOR



The Kaplan Projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

An Engineering Product

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue -:- -:- New York City

MOTION PICTURE PROJECTIONIST

March, 1932 Vol. 5, No. 5

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Mortimer Glancoff

Editorial & Advertising Office
7 West 44th St.
New York City.

I. A. T. S. E. Convention Scheduled for Columbus, Ohio

More than 1,000 delegates including the present executive officers and many representatives of allied industries, are expected to attend the biennial convention of the I.A.T.S.E. which is scheduled to take place at Columbus, Ohio, in the week beginning June 6th. Through the courtesy of the Columbus Chamber of Commerce, Memorial Hall has been placed at the disposal of the Association.

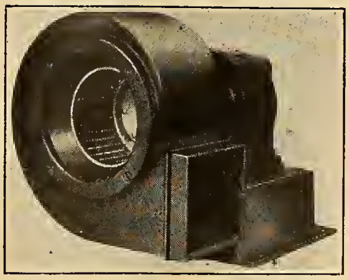
The election of officers to the executive council will, it is said, form the principal business of the convention. It is expected also that some time will be devoted to the discussion of new conditions and rulings of labor contracts for the coming business year. Efforts will likewise be made for the welfare of the union members during the next theatrical season.

Although Louisville, Kentucky and Milwaukee, Wisconsin came in for serious consideration in choosing the convention city, it was felt that, because of its location and accessibility, Columbus would be more acceptable to the members.

A SIMPLE EXPEDIENT NOW BRINGS YOU BETTER PICTURES

A YEAR ago Eastman announced the first super-speed negative film—a medium that helped to set up new artistic standards in the motion picture industry. Now a simple expedient—a gray backing on the film base—gives you *even better* pictures. When you run a release that is truly exceptional in photographic quality, the chances are it was made on this perfected Eastman Super-sensitive Negative. Eastman Kodak Co. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN *SUPER-SENSITIVE*
Panchromatic Negative (*Gray-backed*)



Good Ventilation
means
Long Life
to Machines and Men too

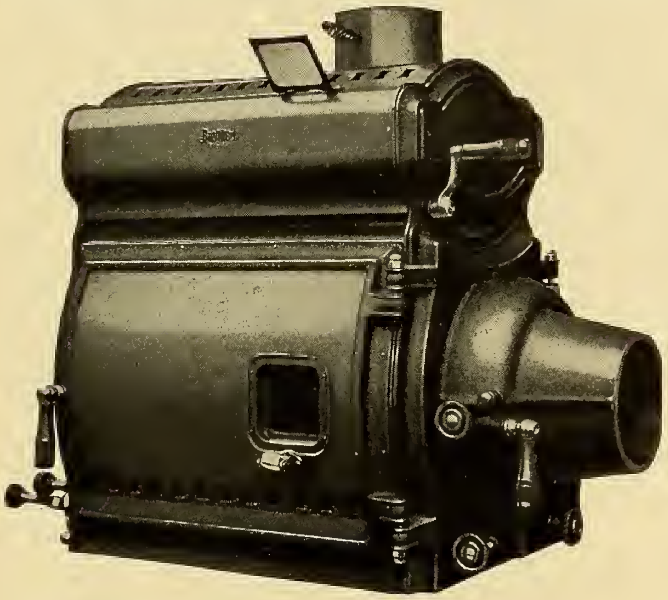
Our Booklet shows how to install. Write now for new Low Prices.

TYPHOON AIR CONDITIONING CO.
233 West 42nd Street, New York City
Phone Wisconsin 7-1296

PROVEN
BY INSTALLATIONS
in many of the largest and finest theatres of the United States

Brenkert

SUPER HIGH INTENSITY
PROJECTION LAMPS



have consistently produced the UTMOST in results with minimum of maintenance expense. A demonstration will convince you of Brenkert leadership in design and operation.

Distributed by Progressive Independent Supply Dealers

Ask Any User

A Brenkert PRODUCT

Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

Academy Plans Extensive Program for Year

AN extensive program for the current year and membership invitations to 23 film people were acted on at the first 1932 meeting of the officers and Board of Directors of the Academy of Motion Picture Arts and Sciences, held on Monday night, February 1, at the Academy headquarters in Hollywood. Changes in the Conciliation procedure of the organization were also approved by the directors.

The Conciliation Committee of the Academy, which functions as a "supreme court" on economic relations disputes within the motion picture industry, will be increased from the present ten members to a panel of fifteen, five new members being appointed each year. In addition, action on complaints against individuals or companies will be speeded up so that any complaint can be heard by the Academy Branch having jurisdiction, within three days.

The Academy is divided into five branches, corresponding to the five major divisions of motion picture production: Directing, Acting, Writing, Production, and Technical. The procedure of the Academy conciliation system is to have the Executive Committee of the branch function as a "grand jury" to decide on whether a complaint is worthy of a hearing before the Conciliation Committee.

The present membership of the Academy Conciliation Committee includes: Chairman J. T. Reed, of the Technicians Branch, with Nathan Levinson, alternate; Actor, Lawrence Grant, alternate, Conrad Nagel; Director, Reginald Barker, alternate, Mervyn LeRoy; Writer, Percy Heath, alternate, John Goodrich; Producer, J. I. Schnitzer, alternate, Louis B. Mayer. Since Schnitzer's new duties with RKO-Radio pictures demand his presence in the East, Al Kaufman, Executive Assistant to B. P. Schulberg at the Paramount-Publix Studios, has been selected to replace him as the new producer member of the committee.

The function of this committee is considered of much importance since it involves adjusting the differences that arise under the pressure of creative work in motion picture production.

Though the committee has functioned very effectively since the Academy's inception in 1927, it was found that increase in its membership would effect speedier action on complaints, since every member of the committee is busily engaged in motion picture production and liable to be called away from Hollywood for considerable periods of time. The increased membership insures a full committee at all times under ordinary circumstances. Inclusion of studio research department directors in the Technicians Branch, under the art director section, was also decided upon by the Academy Board.

Another change in the membership classifications was the inclusion of accredited publicity men as associate members in Producers Branch. It was further decided that film editors would be admitted in the Technicians Branch.

It was announced that the total membership of the Academy now stands at 720, an increase of 119 since January 1, 1931.

More than 200 meetings of Boards, Branches, Committees, Sub-committees and other special groups were required in the conduct of the Academy work during the past year, it was stated, with increased activities planned for 1932.

Officers of the Academy who met with the Board of Directors are: President, M. C. Levee; Vice-President, Conrad Nagel; Treasurer, Frank Lloyd; Secretary, Fred Niblo; and Executive Secretary, Lester Cowan. The Board is composed of M. C. Levee, Conrad Nagel, Frank Lloyd, Jean Hersholt, Lawrence Grant, Donald Crisp, Frank Capra, Irving G. Thalberg, Joseph Johnson, Karl Struss, Nugent H. Slaughter, Max Ree, W. Young, Al Cohn and B. Glazer.

As The EDITOR *Sees* IT

¶ *Needed: A New Stimulus*

IT does not require the mental acumen of a wizard of finance to realize that business is not all that it should be in the motion picture industry. The film trade papers themselves make no secret of the fact. The responsibility for the situation is ascribed to various and sundry causes; principal among them, the widespread collapse of the national economic structure.

That the present financial depression represents an important factor in the decrease of box office receipts is quite probable; but it is entirely possible that it does not possess the all-pervading influence which we are at first thought inclined to believe. Certainly, in some of the larger cities of the country at least, enforced idleness has manifested itself in an increased attendance at afternoon performances. While it cannot be denied that such a condition is financially unsound, and it is problematical just how long it can last, nevertheless it exists and the motion picture theatres are the beneficiaries.

Such of the trouble as may be attributed to the present unsettled financial situation is, like spilt milk, past worrying about. The people of this country, and, in fact, of the world at large, have for the past three years or more been looking for a saviour; and when he appears, if he ever does, the probabilities are that he will not come from the ranks of the motion picture industry.

When all is said concerning the evil effects of the depression upon the industry, the fact remains that there are many thousands, and more probably many millions, of people whose financial circumstances will permit them to attend a motion picture show every day in the week if they so desire, but who rarely if ever indulge in a movie. What the industry needs is less worrying about the financial depression, and more constructive thinking.

Some three years ago, with the advent of sound, there was a tremendous revival of public interest in the motion picture. Today the peak of interest is well in the past. A new stimulus is needed—something to give the industry the necessary impetus to carry it through what we all hope is the fag end of financial depression. What is it to be?

There are several possibilities. We have in the immediate offing Color, Increased Frequency Range and Wide Film. With all of them there is one cogent fact that must be continuously borne in mind. It is this:

While to give an appreciable impetus to the industry at large any technical improvement must be easily recognizable by the general public as such, nevertheless, its adoption must not represent too much of an initial financial outlay on the part of the exhibitor. If it does, under present conditions, the project is foredoomed to failure.

Under these circumstances, it would appear that we have two main avenues of approach: Color and Frequency Range. The third, Wide Film, involving as it does the installation of special equipment, must, for the present at least, be held in abeyance.

In respect to both color and frequency range, although the progress which has already been made is amazing, there still remains much that is worthy of accomplishment. It will be interesting to observe what the next few months have to offer.

¶ *The Future of 16 mm.*

ONE of the strangest phenomena of the motion picture industry today is to be found in the fact that 16 mm. projection has not taken a greater hold on the public consciousness. While it may not possess the flexibility of radio as a medium for home entertainment, it certainly is its equal, if not its superior, in amusement value. Furthermore, projection in the home augments, rather than competes with, the motion picture theatre.

There appear to be several reasons for the present status of the situation. First: The vast majority of the general public does not realize the fascinating interest of home photography and projection. Second: There is a suspicion—not altogether unjustified—that it is expensive. Third: Film exchanges are not readily accessible.

As to the first, there is only one real solution and that is an incessant and effective campaign of publicity. The second, however, presents a serious and far more difficult problem.

The expense involved in home projection does not rest in the initial cost of the equipment, but in its operation. In other words, a good home projector may be purchased for a price which will compare favorably with that of a fair radio set, but the present cost of film and film rentals restrict its use.

This observation is not made in any criticism of present price standards for either films or rentals. In view of present manufacturing costs, handling, mutilation, etc., they are eminently reasonable. However, it is reported on good authority that intensive research is now in progress with a view to simplifying manufacturing methods and lowering production costs. When this day arrives, it will represent a red-letter one in the annals of the 16 mm. film industry. With its arrival, the third problem, that of exchange accessibility, will be obviated in the increased demand for the product.

CHARLES E. BROWNELL.

Care and Operation of the Arc M. G. Set

By T. P. Eldridge

The vital part which the arc motor generator plays in work of picture projection cannot be overestimated. In the article which follows, Mr. Eldridge, who is a member of the Industrial Department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., stresses some important facts concerning the installation, operation and care of conversion units of this type.—The Editor.

THE finest equipment and the most elaborate installation may be shut down by accident, if proper protection and care is not taken. Naturally the projectionist does not want his equipment shut down because of lack of proper care and it is hoped that the following remarks, with reference to projection motor generators, will help him obtain trouble-free operation from this important unit of equipment.

When uncrating the machine, the various units should be protected against severe shocks or blows which might cause damage. When moving the set care should be taken that no undue strain is placed on any part of the set which might cause the machine to get out of alignment.

The motor generator set should be installed in a clean, dry, well-ventilated location and in such a manner as to be easily accessible for inspection and cleaning.

Installing the Equipment

The foundation should be of such a height that the bottom of the bedplate will be approximately two feet above the level of the surrounding floor. The bedplate of the set should be securely bolted down to the foundation after lining up with suitable shims placed between the lower surface of the bedplate and the foundation at six or eight uniformly spaced points. The final lining up should not be attempted until it is possible to run the set under its own power with or without load.

Adjust the thickness of the shims at the various points of support until the vibration, while running, is a minimum with the foundation bolts securely tightened. The bedplate can then be grouted in but if necessary a heavy timber foundation may be used. To prevent the magnetic hum and vibration of the set being transmitted to the surrounding supports, such as floor and walls of the building, a sound and vibration absorbing base may be constructed. This foundation is made of two layers of two-inch plank laid at right angles to each other, under which is placed two layers of two-inch cork which, in turn, should be mounted on a concrete foundation.

Very satisfactory results have been obtained by the use of helical compression springs of suitable size attached underneath the bedplate so that the bedplate is at least ½ inch above the floor. Three or four springs should be placed under each side of the bedplate, depending upon the size of the set, and the springs should be spaced so that the weight is evenly distributed.

Connecting the Unit

Before connecting up the motor generator set, read carefully such instructions as are furnished and check the motor rating with the power line from which the set is to be operated. Before starting the equipment again read the instructions and make sure that the equipment is correctly wired and connected. Now, observe the following instructions in the order named:

1. Open line switch on generator and make certain that field rheostat is set with all resistance in. 2. Start motor in line with instructions furnished with the starter. 3. When motor generator is up to full speed, adjust the voltage to the proper value by means of the field rheostat. 4. Close the switch connecting the generator to the load.

When a generator is started, it may fail to build up its voltage properly. This may occur even though the generator operated satisfactorily during the preceding run. This may be due to one or more of the following causes:

1. Slow speed. 2. Open shunt field circuit, caused by faulty connection or defective field coil or field rheostat. 3. Open armature or commutating field circuit. 4. Incorrect setting of brushes. 5. Reversed series or shunt coil. 6. Poor brush contact due to dirty commutator, or brushes sticking in holders. 7. Loss of residual magnetism.

Hunting the Trouble

Examine all connections, and try a temporarily increased pressure on the brushes; look for a broken or burned out resistor coil in the rheostat. An open circuit in the field winding may sometimes be traced with the aid of a magneto and bell; but this is not a sure test as some magnetos will not ring through a circuit of such high resistance as some field windings have, even though the winding be intact.

If no open circuit is found in the rheostat or in the field winding, the trouble is probably in the armature. If nothing is wrong with the connections or the windings it may be necessary to excite the field from another generator or some other separate source, in order to build up the residual magnetism.

When exciting the fields from some outside source, the easiest method is to raise the brushes on the generator and apply the power to the brush arms of opposite polarity. It is desirable to have a small fuse of about 5 amperes in this test circuit. When the power is applied the field of the generator will show considerable magnetism if it is all right. Caution should be taken in opening this circuit, that is, removing the power from the field circuit.

Use Reduced Voltage

If possible the voltage should be reduced; however, if it is impossible to do this then the field rheostat should be placed in the all resistance, "in" position and the switch should be opened slowly, allowing an arc to be drawn, and this arc should be lengthened out by slowly opening the switch until the arc breaks.

A very simple means of getting a compound wound generator to "pick up" is to short circuit it through a fuse having approximately the current capacity of the generator. If sufficient current to melt this fuse is not generated, it is evident that there is something wrong with the armature,

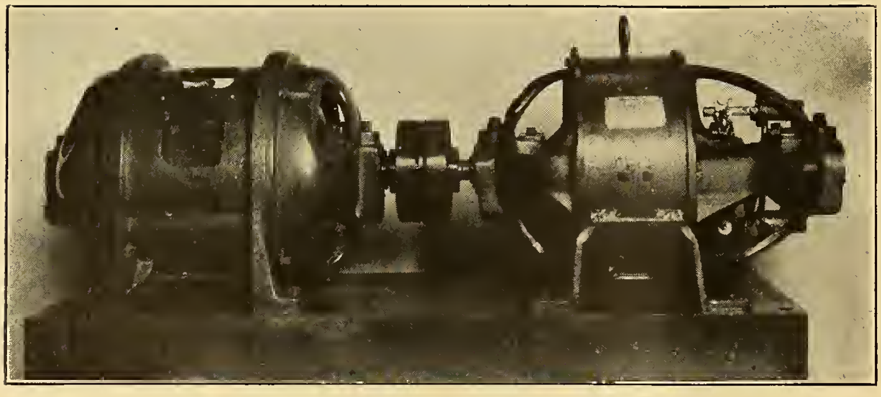


Fig. 1. A Standard Type of Motor Generator

either a short circuit or an open circuit. If, however, the fuse blows, make one more attempt to get the machine to excite itself. If it does not pick up, it is evident that something is wrong with the shunt winding or connection.

If a new machine refuses to build up voltage and the connections apparently are correct, reverse the field connections, that is, interchange the field wires which are connected to the positive and negative terminals of the generator. If this interchange of connections does no good, then change the field wires back to their original connections and locate the fault as previously advised.

Fitting Commutator Brushes

All brush faces resting on the commutator should be fitted to the commutator so that they make good contact over the entire face area. This can be most easily accomplished after brushholders have been adjusted and the brushes inserted. Lift one set of brushes so that they will not be forced against the commutator. Place a piece of sandpaper against the commutator with the sanded side toward the brushes.

Lower one brush in its holder and allow the spring to force it against the sandpaper. Draw the sandpaper in the direction of rotation under the brush, releasing the brush pressure as the paper is drawn back, being careful to keep the ends of the paper as close to the commutator surface as possible and thus avoid rounding the ends of the brush. After the first brush is properly ground, it should be lifted from the commutator, after which the remaining brushes of the set may be similarly ground in one at a time. By this means a satisfactory contact is quickly secured.

Make frequent inspection to see that: 1. Brushes are not sticking in holders. 2. Pig-tail shunts are properly attached to brushes and holder. 3. Tension is readjusted as the brush wears. 4. Worn-out brushes are replaced before they reach their wearing limit and break contact with the commutator. 5. Any free copper picked up by the face of the brushes is removed.

Commutator Care

The generator commutator is perhaps the most important part of the machine in that it is the most sensitive to abuse. Under normal conditions it should require little attention beyond frequent inspection. Keep the commutator clean, wiping it at frequent intervals with a clean canvas cloth free from lint. A piece of paraffin rubbed lightly across the commutator at frequent intervals will furnish sufficient lubrication.

A commutator that is taking on a polish and shows no sign of wear requires no other attention, but a rough, raw, copper-colored commutator should be smoothed with a piece of sandpaper or sandstone ground to fit and polished with No. 00 Sandpaper. Always lift the brushes when polishing the commutator, and do not replace them until all grit has been removed. Never use emery cloth or emery paper on the commutator.

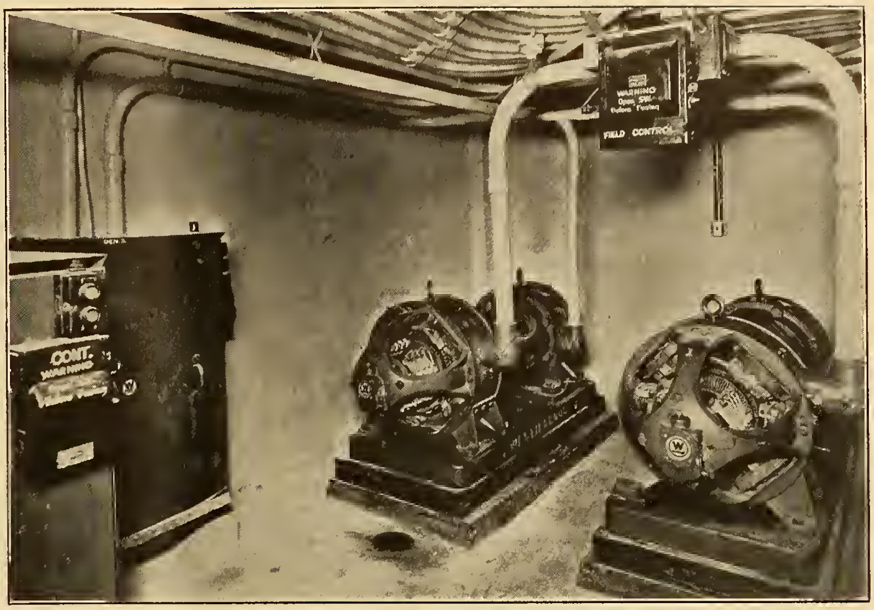


Fig 2. A Modern Motor Generator Room

A good grade of light dynamo oil should be used in sleeve bearings. The bearings should be inspected periodically to make sure that they have sufficient oil. When filling the bearings with oil be careful not to spill oil over the housing or bracket or on the winding of the machine.

Troubles from over-heated bearings are usually due to one of the following causes: 1. Poor lubrication due to failure of oil rings to revolve or due to the use of a poor grade or insufficient quantity of lubricants. 2. Poor alignment causing excessive end thrust or binding. 3. Rough bearing surface. 4. Bent shaft.

If the bearings heat reduce the load, if possible, and feed a liberal supply of good lubricant. If the bearings continue to heat, it will then be necessary to shut down the set, keeping the armature revolving slowly until the bearings cool in order to prevent sticking or freezing.

Spare Parts Stock

Carry an adequate stock of wearing parts. This stock is an inexpensive operating insurance and will more than pay for itself by reducing the length of shut-down time in case of trouble.

Expensive repairs may often be prevented by renewing an inexpensive part before it has worn sufficiently to cause damage to other parts. Keep a stock of wearing parts such as bearings, brushes, etc., on hand at all times.

The most important feature of all is to keep the motor generator set clean and dry. Tools, bolts, oilcans, etc., should not be allowed to lie around on the motor and generator frames. Keep both motor and generator free from dust by occasionally blowing out with compressed air hose or hand bellows. The insulation must be kept clean and dry. Oil and dirt in the insulation are as much out of place as grit or sand in a cylinder or bearing.

Rockefeller-Radio City Unit's Steel Work Completed

The steel work of the first building to be erected in the Rockefeller midcity building center is virtually completed. This is the 31-story R-K-O Building on Sixth avenue between Fiftieth and Fifty-first streets. The "topping out" ceremony was held on Monday, February 8th, by John Lowry, Inc., general contractors, and Post & McCord, who have erected the steel. This ceremony consisted of the unfurling of two American flags atop the steel skeleton—more than 400 feet in the air—one at the northwest corner and one at the southwest corner of the building.

This structure, which is to be occupied largely by the executive offices of the Radio-Keith-Orpheum Corporation, is the first large modern office building to be erected on Sixth avenue north of Forty-second street. It will be ready for occupancy next October.

The first structural steel columns and beams for the R-K-O Building arrived on the site November 30th. Erection was started immediately and has proceeded at the rate of three stories a week. The total amount of structural steel riveted into place will exceed 7,500 tons.

Excavation for the building was started in July by Clarence L. Smith, Inc., and was completed late in October. The first concrete foundation piers were poured on September 11th.

The Problem of Non-Intermittent Projection*

By Fordyce Tuttle and Charles D. Reid †

A summary of the advantages claimed for non-intermittent projectors is given. This is followed by a list of questions which the writers think should be answered with regard to any projector of this type. The various projector types are then classified according to the optical means used to form a fixed image. Two types of error are noted and each type of projector listed is discussed keeping these in mind.

IT has been the privilege of the authors to review the several hundred patents which have been granted on non-intermittent motion picture projectors. We have found that the problem of producing a satisfactory screen image from moving film by means of moving optical parts is not a simple one, and it seems desirable to discuss the difficulties encountered in the design of the several types of such projectors.

Since any non-intermittent projector would have to compete with the intermittent machine, and since the optics of the former admittedly will have to be more complicated, we must consider what offsetting advantages may be possessed by the non-intermittent projector.

Summary of Advantages

A summary of the advantages claimed follows:

1. There might be less wear and tear on film which is pulled at a constant linear velocity through a machine than on film which is intermittently accelerated by a machine.

2. There would probably be less difficulty in running film already damaged through a non-intermittent machine. With the intermittent projector, a few successive damaged perforations cause the loss of the loop, and further damage to the perforations until the loop is restored. The non-intermittent machine will usually restore itself to a running condition even though the film be damaged over a considerable length.

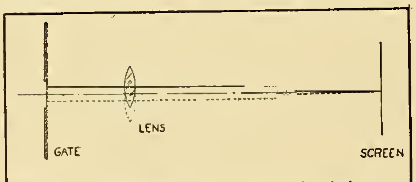


Fig. 1. Optical compensation for film motion by a single moving lens

3. There is a possibility that there might be more total light to the screen, since no shutter is needed to cover up the movement of the film.

4. There might be a better portrayal of action if each picture is allowed to blend into the successive picture.

5. If the light to the screen can be kept constant at all times during the projection cycles, it may be possible to eliminate flicker entirely. Some inventors have argued that the interruptions to the light, even though of frequencies high enough to eliminate visible flicker, cause some eyestrain.

Less Noise and Wear

6. The ideal non-intermittent machine might be much less noisy. In the present intermittent machine, certainly a large part of the noise comes from the intermittent pull-down and from the film moving intermittently in the loops and through the gate.

7. There might be less trouble with wear in the non-intermittent machine. In the intermittent machine wear in the pull-down parts causes unsteadiness.

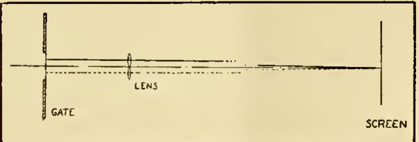


Fig. 2. Optical compensation for film motion by a plurality of moving lenses.

8. In a portable sound-on-film projector, there might be a number of mechanical advantages in not having to have the film moving intermittently at the picture aperture and continuously at the sound gate.

None of these possible advantages is great enough to offset any serious imperfections in the projected picture, such as unsteadiness, distortion, and poor definition. This does not mean that we would be right in insisting on theoretical perfection in the projected picture.

Practically every non-intermittent machine involves approximations, and in studying these machines we have found it desirable to set up more or less arbitrary standards for theoretical steadiness, distortion, and definition. If we make these standards about equivalent to the practical standards of the intermittent machine, we could allow about the following approximations:

1. Steadiness of the center part of the picture plus or minus .0005″ (referred to the film frame).

2. Distortion movement in the corners of the frame plus or minus .001″.

3. Definition

a. In the center of the frame .001″ (circle confusion).

b. In the corners .002″.

With intermittent equipment, considering the errors in the camera, the printer, and the projector, we are fortunate if successive frames are registered in the projector gate closer than plus or minus .0005″, which makes our steadiness tolerance seem reasonable. Twice the movement has been allowed in the corners of the frame that was thought permissible for the center of the frame, because of the belief that the eye is not particularly concerned with movement away from the center of interest. The definition tolerances used here are equivalent to those usually found in practice in motion picture work. With regard to definition, it has been observed that if the definition is poor during some parts of the projection period, but good during other parts of the projection period, the eye sees definition that is somewhat better than the arithmetical time average of the definition.

Before listing the different classes of non-intermittent projectors and outlining the difficulties encountered in their design, the following questions are presented as those which we think should be answered with regard to any of these projectors.

Questions on Subject

1. Is the center point of the picture stationary within sensible limits?

2. Does distortion give a "rubbery" effect in the picture, or does it make corner definition too poor to be acceptable?

3. Is the definition in the picture comparable with intermittent projection?

4. Is the picture made flat by flare from many free glass-air surfaces?

5. Does the system permit of fading out of one picture into the next?

6. Does the system impose limitations on the *F* aperture of the projection lenses?

7. Is the light lost by passing through many surfaces or from reflections serious?

8. Is the light to the screen during the changeover period equal to the light when projecting wholly from a single frame, or it is necessary to introduce diaphragms or shutters which cut down on the light?

9. Does the system require a special moving condenser system?

10. If cams are used, what is the precision required in cutting the cam? Are the surfaces such that they can be cut with precision from point to point?

11. What precision is required in the gear trains connecting film drive with optical displacement means?

12. What precision is required in the sprocket exactly fitting the film? Is a jump back as one tooth leaves a perforation and the next tooth starts to drive serious?

---

* Journal, Optical Society of America.

† Development Department, Eastman Kodak Co., Rochester, N. Y.

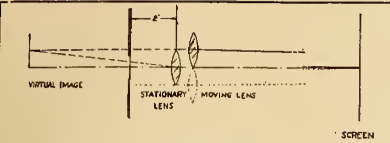


FIG. 3. *Optical compensation for film motion by a plurality of moving lenses and a fixed lens forming a virtual image of moving film.*

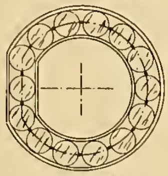


FIG. 4. *One type of constricted path to give a linear motion to the moving lenses.*

13. What precision is required in initial adjustment?

14. What precision is required in the making or matching of optical parts?

15. Does the system impose impractical limitations on the equivalent focus or the back focus of lenses?

16. Does the system demand ridiculous physical dimensions in the projector?

17. Does the system necessitate a fixed screen distance or a fixed magnification?

18. Is the system capable of projecting lenticulated color film? (Kodacolor.)

19. Is a special arrangement of pictures on the film or a special type of film assumed?

20. What type of framing device is required?

21. Are all moving parts moving with constant angular velocity and can all of them be counterbalanced?

22. How does the mass and moment of inertia of reciprocating parts compare with the mass and moment of inertia of the intermittent projector parts?

Optical Requirements

23. Is it necessary to use simple lenses of large *F* apertures covering large fields?

24. Is it assumed that a single image-forming reflector working with a large aperture will cover a considerable field?

25. Is it necessary to assume that a warped reflecting or refracting optical part can be made with great precision?

26. Does the system demand the use of large aperture crossed cylindrical lenses to work as a well corrected spherical lens?

It is conceivable that any device for refracting or reflecting light might be used to give an optical displacement to an image which would compensate for the movement of the film. The following list indicates the elements which have been used, with a very short description of how they were moved.

Moving Lenses
  Reciprocating lenses
  Linear motion of lenses in restricted path
  Circular motion (optical axes describing cylinder)
  Circular motion (optical axes radial)
  Circular motion of cylindrical lenses
Plane Parallel Plates
  Uniformly rotating cube or hexagonal prism
  Cam rotated plate
  Uniformly rotating plate with normal to the plate describing a cone
Refracting Prisms
  Cam actuated variable angle liquid prism
  Uniformly rotating warped refracting elements
  Equal prisms cam rotated equally and oppositely
Reflecting Plane Mirrors
  Cam reciprocated mirror
  Cam actuated series of mirrors
  Uniform rotating drum of mirrors
  Helical reflecting surfaces
  Rotating rhombs
  Moving right angle reflectors
Skewed Image Forming Elements
  Concave spiraled mirror
  Spiraled lens

In the discussion of these displacement means, we would like to point out two types of errors that occur:

1. Errors that are inherent in the displacement means employed.
2. Errors which result from the method used in moving the displacement means.

Moving Lenses

Perfect lenses can be moved theoretically in such a manner that there is no inherent defect in the displaced image produced. In practice the means of moving the lenses and the use of simple lenses introduce difficulties.

If we move a lens, as in Fig. 1, in such a way that a straight line at all times passes through the center of the picture frame, the center of the lens and the center of the screen, we will have a stationary image on the screen from film which is moving. We can design a cam which will reciprocate a single lens in this manner, but we must have a shutter which will cover up the return of the lens, and must introduce flicker blades which will give high frequency interruptions. Further, the cam would have to be accurate to plus or minus .0005″. The mass we are accelerating in such a system is larger than in an intermittent projector, and the same aperture lens cannot give the same amount of light to the screen without a larger source or a moving condenser system. Our first attempt at improvement on this system probably would be to try to have a series of lenses moving in a straight path in front of the film so spaced that when one lens is following one frame from the top to the bottom of a two-frame aperture, the next lens is ready to follow the next frame. This system would allow us to do without the shutter for covering the return of the lens. It would be very difficult, however, to keep the light to the screen constant as we change from one frame to the next, and we would very likely end up with some type of shutter or diaphragm in the system which would reduce the light. With two lenses in the position shown in Fig. 2, we can see that the physical diameter of the lenses is limited to a little less than the height of the frame. If the lens has a focal length long enough to cover the frame satisfactorily, we find that this limits the *F* aperture to a maximum of something like *f*/4, if we allow a minimum of lost space for the mount.

Gain in Aperture

We can gain considerably in the aperture of the system if we use the arrangement shown in Fig. 3. A stationary lens subtending an *f*/2 angle forms an enlarged virtual image of the film and the moving lenses move so that a straight line connects the center of the virtual image, the center of the moving lens, and the center of the screen. With 16 mm. film projected with the equivalent of a 2″ lens, we can have *f*/2 light to the screen at all times using moving lens elements which have apertures of only about *f*/6.

With this system the ratio of the physical diameter of the moving element to the diameter of the stationary lens will determine the manner in which we may fade out of one picture into the next. If the diameter of the moving element is equal to the diameter of the stationary element, we will be constantly changing from one picture to the next. If the diameter of the moving element is much larger than the diameter of the stationary lens, we may divide the projection cycle so that during only half the time we are fading out from one picture to the next.

With 35 mm. film projected with the equivalent of a 5″ lens, we can get *f*/2 light again by using *f*/6 elements. With either film, if we can afford to increase the equivalent focus of the projection system, we can use moving elements which have smaller *F* apertures and have to cover smaller angular fields. Thus, we see that it may become possible for us to use comparatively simple moving lenses which is much better than having to

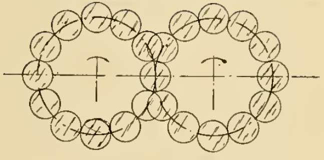


FIG. 5. *Two wheels of lenses used to avoid the horizontal displacement produced by a single wheel*

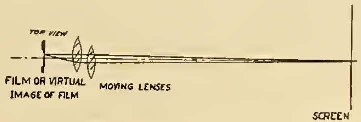


FIG. 6. *Optical diagram showing the paths of rays through the double wheel of lenses.*

use and to move a lot of well corrected lenses.

Other Arrangements

Other arrangements of a moving-lens optical system are possible. The moving lenses working on real or virtual objects can be used to form stationary real or virtual images. It is possible also to consider negative lenses in some cases for the moving lenses. Detailed discussion of all types is beyond the scope of this paper.

The problem of moving lenses in a straight path at a constant linear speed past the gate is not very easily solved mechanically. Several inventors have shown lenses in a belt which move in a restricted path as shown in Fig. 4, with the lenses either linked together or crowding each other along in a channel with a drive for the lenses supplied at some circular part of the path by some kind of rotating sprocket. Such a system, however, is usually noisy and inconvenient.

Use of Lens Wheel

Fig. 5 shows the lenses arranged about a wheel. A single wheel would give the lenses an undesired horizontal displacement equal to the sagitta of the arc over which the lens is used. The optical effect of the horizontal displacement can be offset, however, if a similar wheel of lenses rotating about another axis is used as shown in Fig. 5. Fig. 6 is a top view of the lenses arranged in two wheels, showing how the horizontal displacement of the two lenses is opposite, and they can be made to give zero optical displacement, if the focal lengths and the magnifications for each lens is correct.

The vertical component of the displacement varies as the sine of the angle through which the lens wheel is rotated. If we turn the wheels at a constant angular velocity, we will find it necessary then to have the film pass over a curved gate, if we insist that the image of the center point of the frame be made exactly stationary on the screen. The use of this curved gate, however, will introduce distortion in the picture. By making a compromise between distortion and steadiness, satisfactory projection can be obtained with the system described, if the two wheels used each contain a sufficient number of lenses.

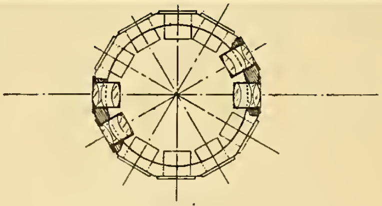


FIG. 7. *A drum of lenses used for optical compensation.*

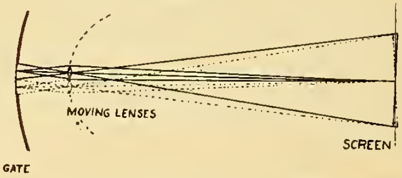


FIG. 8. *The optical diagram for the system shown in Fig. 7*

Fig. 7 shows another arrangement of lenses in a wheel. This arrangement of lenses when used with a straight gate will give undesirable keystoning of the image on the screen, since all parts of the film are not the same distance from the plane of the lens. Even a curved gate will not rid us of this defect for the image plane is not fixed. Fig. 8 shows the way the image surface shifts with respect to the screen. However, if a large enough number of lenses is used in the wheel, satisfactory projection can be achieved.

(To be continued)

S.M.P.E. Committee Activities

Sound Committee

THE Sound Committee of the Society of Motion Picture Engineers is this year extending its activities to include research on the various acoustical problems involved in the projection of high-quality pictures. Among the matters which are being considered under the chairmanship of Mr. H. B. Santee is included the formulation of a definition for the typical theater in which high-quality reproduction may be obtained. By determining the requisite factors which might be found in such an "optimum" theater, and their appropriate specifications, a reference standard will be available in the form of a hypothetical theater, or an exemplar, the acoustical properties of which may be emulated in actual theaters.

The Committee is also looking into the various methods and conditions of conducting acoustical tests, recognizing the fact that many of the data heretofore resulting from such tests were not only unreliable but in many cases actually erroneous. Data on acoustical absorption of materials are to be obtained, and a study is to be made of the various methods of applying acoustic materials and the most advantageous places in the theater at which to apply these materials.

Among the remaining matters to be considered by the Committee are (1) the difficulties which may arise from the misapplication of formulas for calculating the time of reverberation and other acoustical quantities; (2) the roles that the acoustical properties of auditoriums play with reference to attempts to extend the ranges of frequency and volume in recording and reproducing; (3) ambient noises emanating from ventilating systems, projection rooms, and the like; (4) the relation between the acoustical properties of studios and those of the theater, and (5) variations in negative exposures.

Those participating in the work of the Committee are Mr. H. B. Santee, chairman, and Messrs. M. C. Batsel, P. H. Evans, N. M. LaPorte, E. W. Kellogg, C. L. Lootens, W. C. Miller, H. C. Silent, R. V. Terry, and S. K. Wolf.

Sub-Committee on 16 mm. Sound

AT recent meetings of the body appointed to study the problem of establishing dimensional standards for 16 mm. sound film, a subcommittee of the Committee on Standards and Nomenclature of the Society of Motion Picture Engineers, a general agreement was reached under which two sets of specifications would be submitted to the entire Committee on Standards for validation and approval.

The first plan included the specifications for a layout involving only a single row of perforations, which is to be recommended for adoption; the second lay-out calls for two rows ot perforations, this plan to be submitted as an alternative, in the nature of a minority report, which may be followed if the trend of the art is in that direction.

Much deliberation was necessary in order to arrive at these conclusions on account of the many considerations involved not only in the specifications themselves, but in the commercial and practical aspects of the industry and the art.

Scope of Work

Among these various considerations may be included the questions of fixed or variable apertures, the conformity of the projected picture shape with the shape of existing screens, the requisite screen illumination and allowable magnification of the picture, the possibility of using duplicate negatives for printing, of reversing the film in the gate, of running the film in existing projectors, the possibility of encountering sprocket hole modulation, the use of optical reduction methods in printing, and a host of other questions.

The work of the subcommittee was directed by Mr. J. L. Spence, chairman; those assisting in the work were Messrs. V. B. Sease, P. H. Evans, L. A. Jones, H. T. Jermaine, H. Griffin, R. P. May, T. E. Shea, L. A. Elmer, and H. G. Tasker. The recommendations of the subcommittee will be acted upon by the entire Standards Committee, under the chairmanship of Mr. M. C. Batsel.

The Fundamentals of Sound

By LEDWARD EVERETT

IT is doubtless true in the field of projection, as it is in any other business or profession, that one can often "get by" with a minimum supply of knowledge. Just as one does not necessarily have to possess a knowledge of the chemical composition of water in order to use it in a steam boiler, so one does not have to have an understanding of the principles of sound in order to express one's thoughts in speech or to operate a sound equipment.

Nevertheless, in the case of the steam boiler, a knowledge of the chemical composition of the water one intended to put into it might easily be the means of avoiding harmful chemical reactions, and in the same way a comprehensive appreciation of the principles of sound may well enable the projectionist to perform his work in a more intelligent and efficient manner. It is with this thought in mind that the following dissertation on the theory of sound has been prepared for the projectionist.

The Nature of Sound

For all practical purposes sound may be defined as that which is audible; that is, perceptible to the human ear. Its production is effected by means of a vibrating body or medium. Sound is transmitted or carried from place to place in many ways. The medium may be a solid or a liquid or it may be a lighter medium, such as air or gas. That which most concerns us, however, is the transmission of sound through the medium of air, because it is through this medium that we usually receive those sensations defined by the name "sound."

The speed of sound varies in accordance with the medium through which it travels. Its speed in air has been established at approximately 1,100 feet per second. Through water, however, its speed is approximately five times greater, and through a solid substance, such as steel, its speed increases to about fifteen times its speed in air.

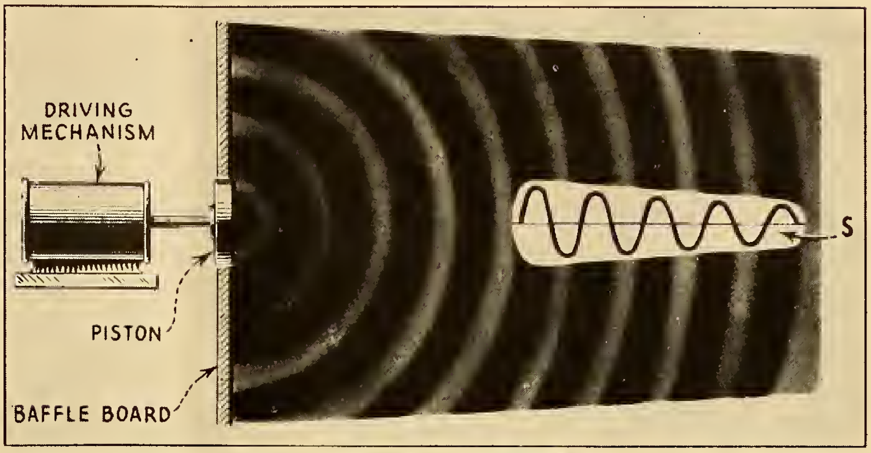


Fig. 1. Production of Sound Waves

The production of sound in air is accomplished by setting up air waves, that is, any object or material which is in a state of vibration or oscillation acts upon the surrounding air in such a manner as to radiate a series of air waves. These air (or sound) waves radiate in the same direction or plane as the movement of the object which causes them. This statement may be understood better by referring to Fig. 1, in which is illustrated a simple generator of sound waves.

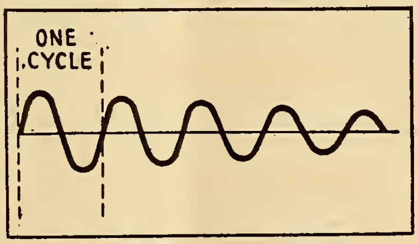


Fig. 2. Wave, Showing Cycles

When the piston shown in the drawing moves to and fro through the hole in the baffleboard, the effect is as follows: On its forward journey (or to the right) it pushes the particles of air before it. The air is thus compressed by the action of the piston, and the compressed area travels outward in the same direction in which it was pushed. Such bands of compressed air are known as areas of compression. In the drawing they are represented by the heavily shaded areas.

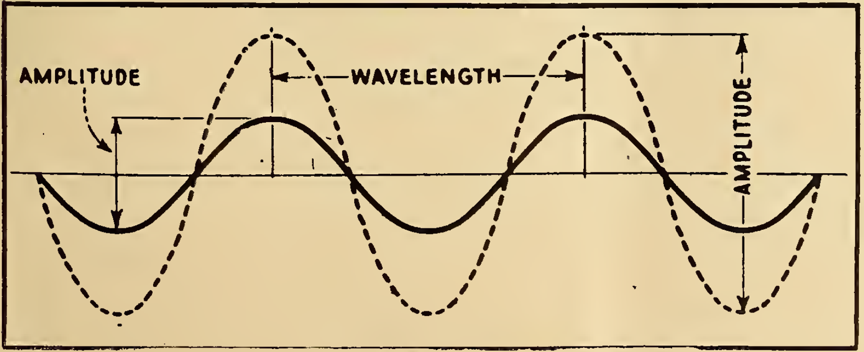


Fig. 3. Sketch Showing Wave Length and Amplitude

Area of Rarefaction

On the return journey, as the piston moves back to its original position and beyond it, the air rushes into the space which it has occupied, but does not have time to fill it completely before the succeeding forward movement of the piston occurs. The result is that an area of low pressure or partial vacuum is created which, following the area of compression, travels outward from the piston. This band or area of low pressure is called in sound parlance the area of rarefaction, because within that area the air is rarefied and the pressure subnormal.

A sine wave corresponding to the movement of these bands or areas is also shown in Fig. 1. It is to be observed that the positive half of a cycle corresponds to an area of compression and the negative half to an area of rarefaction.

When the piston is not in operation the air is in a state of rest. We assume that it stops in the mid-position of its stroke. This is indicated in the sine wave of Fig. 1 by the horizontal line which passes through the middle of the wave separating the positive or compressed and the negative or rarefied halves of the wave.

As the piston moves back and forth it produces the alternate areas of compression and rarefaction indicated in the drawing. These bands travel outward until they strike some object or are dissipated in strength to such a degree that practically speaking the air has reached a state of rest. The decrease in the strength of the sound wave as it moves outward from its source is indicated by the decreasing amplitude of the suc-

(*Continued on page 27*)

Vertical Sound Records

By HALSEY A. FREDERICK

No single development of the past year has aroused more widespread interest on the part of the Industry, and in fact of the public at large, than the new vertical cut disc record, a product of the Bell Telephone Laboratories. The only information of a reliable character concerning the record and the process which it involves was contained in the recent lecture by Mr. Halsey A. Frederick, first presented at Swampscott and later at New York before the Society of Motion Picture Engineers. This lecture is now available and, in response to the many requests which we have received from our readers, it is reproduced herewith through the courtesy of the Society Journal.—THE EDITOR.

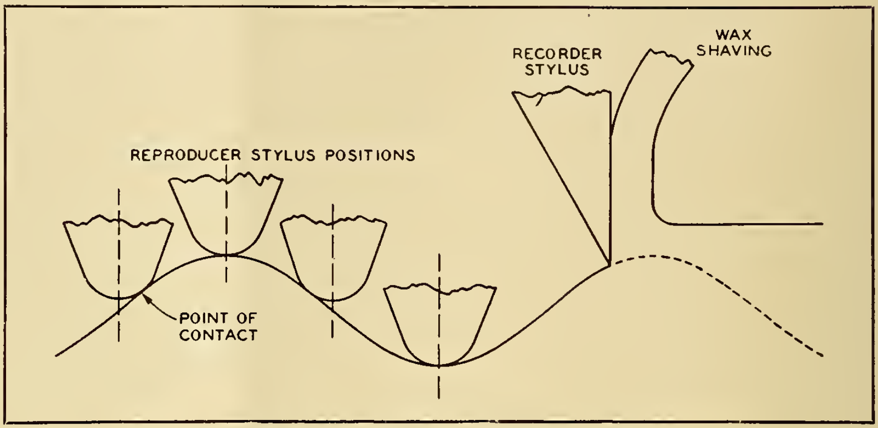


Fig. 2. Distortion in Vertical Groove

At the convention of this Society held at Lake Placid in the fall of 1928, data were presented showing that a very good frequency characteristic could be obtained in recording and reproducing by means of the "lateral" disk recording system. The data presented at that time had to do chiefly with the response-frequency characteristics of the elements which entered into that system. The information then available, however, about non-linear distortion was somewhat limited. That discussion, in addition, did not attempt to cover the limitations imposed by background noise commonly called "surface" or "needle scratch."

In most commercial uses of lateral records, surface noise has imposed very serious limitations. In many cases this noise has been suppressed by the use of so-called "scratch" filters. These have effectively quieted the reproduction but only by the sacrifice of an important portion of the recorded band of frequencies which are above 3,000 to 4,000 cycles. Investigations have been carried on to determine the fundamental causes and the characteristics of the surface noise in order that, with a better understanding, it might be more effectively reduced and without such a sacrifice.

In addition to the limitations imposed by surface noise, other studies have indicated that, with the available reproducers for lateral cut records, the needle point may fail to follow the center of the groove accurately when the curvature becomes too sharp, and may skid from side to side by varying amounts, depending on the record and the characteristics of the reproducer being used. Studies have proceeded relating to the physical characteristics necessary in a reproducer in order that it may faithfully follow a groove. These studies have led us to expect superior performance from a groove cut with vertical undulations than from one with lateral undulations. These records are similar in principle to those used by Mr. Edison.

With the lateral groove there is distortion due to the fact that the sound is recorded with a chisel-shaped stylus and reproduced with a round stylus; also that in reproduction the bearing point of the stylus against the groove shifts forward and backward as the needle rounds a curve. These effects are illustrated in Fig. 1.

With vertical records the first of these effects, sometimes called the "pinch" effect, is absent, but a shifting of the bearing point of the reproducing stylus forward and backward occurs if a round stylus is used. It is doubtful if a chisel-shaped reproducing stylus or a stylus with an elliptical point can be justified due to the increased cost and complication, and in consideration of the rather small amount of distortion which this would eliminate. Some qualitative idea of what takes place with vertical undulations may be gained from Fig. 2, in which a sine wave is shown together with the resulting positions of the stylus point. For a given stylus tip radius and for a given recording level this effect increases with frequency.

This failure of a stylus point to follow a vertical record with great accuracy is, of course, due to the finite length of the stylus point along the groove. A fact which relieves this situation is that speech and music and most other sounds in which we are interested in recording contain much less energy in the high than in the low frequency range.

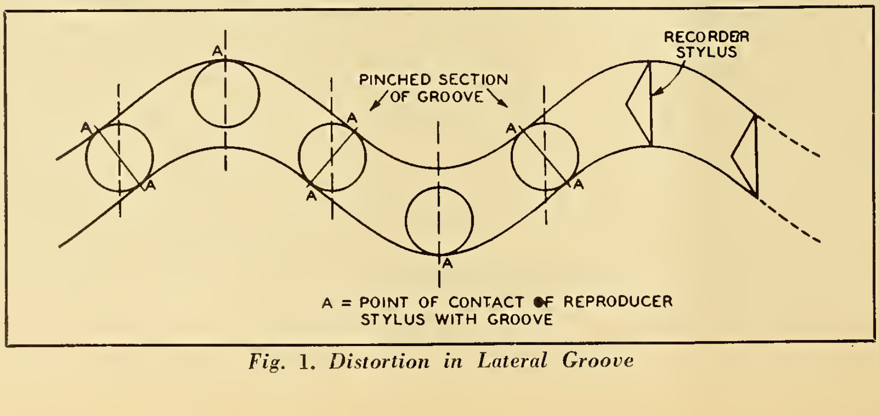

PINCHED SECTION OF GROOVE
RECORDER STYLUS
A
A
A
A
A
A
A
A
A = POINT OF CONTACT OF REPRODUCER STYLUS WITH GROOVE

Fig. 1. Distortion in Lateral Groove

Surface Noise Analyses

Frequency analyses of surface noise have been made using a variety of reproducers and record materials. In general, these frequency characteristics have been found to be very largely influenced by the characteristics of the reproducers, but do not show any marked differences as between lateral and vertical recordings. Frequency charts of surface noise taken with a vertical reproducer having a very flat frequency characteristic over the audible range have shown the surface noise to be relatively richer in high frequencies. The distribution of surface noise energy below 10,000 cycles from a cellulose acetate pressing is shown in Fig. 3.

The amount of recorded sound energy in the low frequency range, *i. e.*, below about 2,000 or 3,000 cycles, however, is large, relative to that in the higher frequency ranges. Moreover, the characteristics of many lateral reproducers have been such as to accentuate surface noise between 3,000 and 5,000 cycles. Hence the use of "scratch" filters for the elimination of the high frequency components of the surface have made a large effective reduction in noise without any material loss in loudness of the sounds of interest. The loss in loudness at the higher frequencies has also reduced the audible distortion due to poor traction and, although the loss of the higher frequencies is serious, it has been held by many that the end has justified the means.

Surface noise is probably caused by a more or less random distribution of impulsive shocks on the needle due to minute irregularities in the record. It has been common practice in lateral recording to use record material containing a certain amount of abrasive in order to grind the needle to fit the groove. The irregularities due to the abrasive would logically be expected to produce a scratchy noise of much the character with which we are all familiar. A 5,000-cycle note of the same loudness as a 10,000-cycle band of surface noise using a reproducer with a flat characteristic would have an amplitude of only about 0.000001 inch.

In order to reduce the surface noise to the point where it is no longer troublesome, it appears necessary to eliminate irregularities at least down to this order of magnitude. It has been found that, if the usual abrasive record were replaced by an unabrasive record pressed of a very clean homogeneous material such as cellulose acetate, the surface noise caused by the record material itself would be greatly reduced. Such a change, however, by itself, has been found to give a comparatively minor improvement; for, when this cause is moved well into the background, other causes of surface noise of practically the same order of magnitude as that due to the abrasive of a shellac record become controlling.

Other Improvements

The next process which it has been found necessary to improve has been that of rendering the surface of the original wax electrically conducting. The usual methods of graphiting or brushing with fine electrically conducting powders have been found unsatisfactory. Recourse has therefore been had to one of the earlier methods used in phonograph practice, namely, cathode sputtering of the wax.

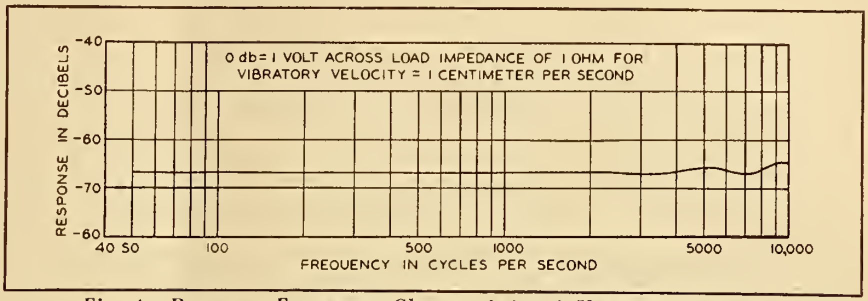


Fig. 4. Response Frequency Characteristic of Vertical Reproducer

This method was not devoid of difficulty, however. With the best sputtering technic the usual thick "waxes" are heated to such an extent as to injure or destroy their finely engraved surfaces. By using a very thin layer of wax flowed on a metal surface it is possible to keep it cool during the sputtering operation. It is thus possible to apply an extremely uniform, smooth, and tenacious surface of metal of adequate thickness in a very few minutes. This can be electroplated by the ordinary methods, and the electroplate used for pressing the final record.

Smooth Surface Texture

By using this thinly flowed wax, it is possible to obtain a surface texture which is extremely smooth and homogeneous and which is also free from the mechanical strains incident to shaving the waxes by the methods previously commonly used. In addition, waxes of this type possess obvious advantages in ease of transportation, ruggedness, *etc.*

When the noise due to the two causes discussed above has been removed or largely reduced, a third source of noise is apt to become prominent. This involves the reaction of the wax shaving on the recording stylus, which appears on the final record as "clicks" when the shaving breaks or is removed in a non-uniform manner. It has, however, been found possible by suitable design to provide a recorder, stylus, and suction arrangement such that the shaving is removed in a very smooth stream, thus eliminating this type of noise to a large extent.

Making the "Master"

It has been common practice in the past to provide duplicate stampers by electroplating the first stamper or "master" to obtain a negative metal record. This in turn has been plated to provide the duplicate stamper. A convenient and quick alternative method is provided by sputtering and plating a suitable pressing made directly from the "master."

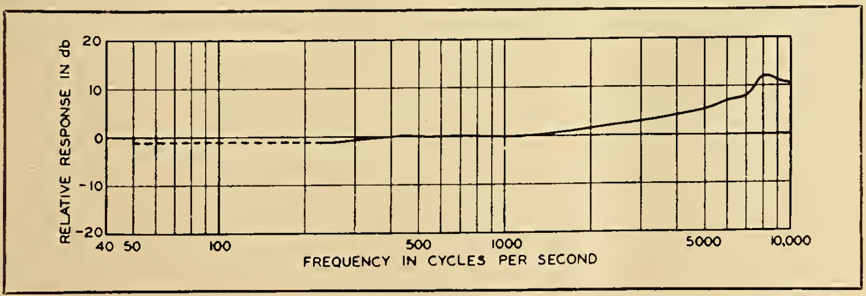


Fig. 3. Energy Distribution of Surface Noise from a Cellulose Acetate Record

These improvements in the methods of engraving and processing, and in the final record material are more or less applicable to either type of recording, lateral or vertical. Their full value, however, can only be realized provided full advantage may be taken of the increased frequency range which greater quietness permits. It is possible to take advantage of this improvement to effect other improvements or economies rather than to use it all in the one direction of decreased noise. In amount, the reduction in surface noise from that of present commercial records will differ depending on the frequency range reproduced.

Surface Noise Reduced

If a blank groove record, made with the improvements noted above, is reproduced by a reproducer which is uniformly responsive up to 10,000 cycles, the surface noise is 20 db. below that of an old type record reproduced in the same manner. If, however, all frequencies above 5000 cycles are eliminated in each case, the difference is 15 db. If now the noise of the new record reproduced to 10,000 cycles is compared with the old record reproduced to 5000 cycles only, which is the comparison of greatest practical interest, the difference in noise is about 15 db.

In addition, it is possible to take advantage of the fact that most sounds to be recorded contain less energy in the high frequency range than in the medium or low frequency range, and to record the higher frequencies at a level somewhat higher than normal. In reproduction these higher frequencies are then correspondingly reduced by the reproducing amplifier or circuit. It is thus found that a further reduction of about 10 db. in surface noise can be obtained, the amount depending somewhat on the high frequency cut-off of the reproducer or circuit. This effect occurs chiefly between 5000 and 10,000 cycles.

The "volume range" for any particular frequency band is usually considered to be the difference in decibels between the loudness of the surface noise and the loudness of the

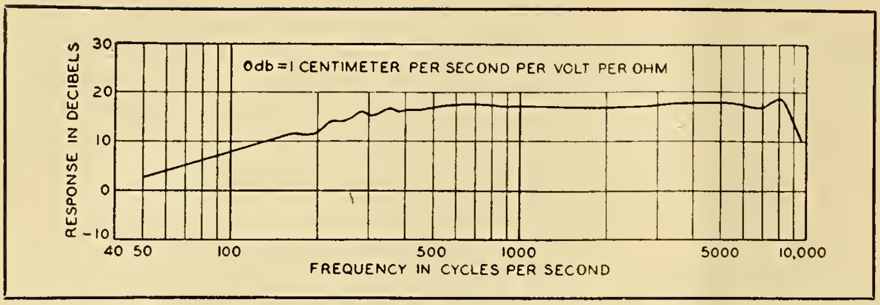


Fig. 5. Response Frequency Characteristic of Vertical Recorder

maximum recorded sound which the record can accommodate when reproduced faithfully over this frequency range. With the lateral records of the past, reproduced to 5000 cycles, this volume range may be stated as about 25 to 30 db. This figure obviously will differ somewhat for different cases, depending on the character of the sounds recorded and on the degree of excellence obtained with the recording and processing methods throughout.

With vertical recording the reductions in surface noise described above increase the volume range for a 5000-cycle band of frequencies to from 50 to 55 db. For 10,000-cycle reproduction the volume range is 45 to 50 db. Obviously, these new facilities open the door for very great improvements in fidelity of reproduction and for the reproduction of many effects not possible in the past. In many cases it means that the surface noise may be reduced to inaudibility.

The Recording Stylus

Lateral records have usually been cut with a stylus having a tip radius between 0.002 inch and 0.003 inch. The angle between the two sides has, in this country, commonly been about 90 degrees. The groove has been 0.002 inch to 0.003 inch deep and about 0.006 inch to 0.007 inch wide. The groove spacing has been 0.010 inch to 0.011 inch so that the uncut space between blank grooves has been 0.003 inch to 0.004 inch. If one groove is not cut over into the next, the maximum amplitude which can be used is limited to about 0.002 inch. If the usual loudness of the record is to be maintained it is necessary to maintain this spacing between grooves.

With vertical records it has been found desirable, particularly where a very loud record is to be made, to use a recording stylus with approximately the same tip radius as previously used with lateral records, but to reduce the divergence between the sides of the stylus above the tip. In addition, it has not been found necessary to provide any clearance space between grooves. In fact, it has been found entirely satisfactory to have the side of one groove cut consistently into the next. It is therefore entirely feasible to increase the number of grooves per inch from the usual 98 to between 125 and 150, at the same time that the recording level is increased.

When using this recording stylus with the lesser divergence for cutting a record with 125 to 150 threads per inch, it has been found desirable to make the groove about 0.007 inch wide and about 0.003 inch deep. The maximum amplitude may, under these conditions, be increased about 4 db. It has been found possible, however, to obtain satisfactory results with most waxes even though the normal depth of the groove is increased to as much as 0.004 inch to 0.006 inch. In this case, the recorded level may be increased 6 db. This increase in the recording level obviously increases the volume range by a like amount.

If occasionally, due to a loud crash of sound, the recording stylus completely leaves the wax, the reproducer will still "track" satisfactorily; that is, continue in the correct groove. The corresponding situation with a lateral record where one groove cuts into another is, of course, fatal since in such a case the reproducer will usually cross into the next groove.

It has been found desirable with vertically cut records to use a permanent reproducing stylus in order to reduce the vibrating mass of the reproducer to a satisfactory value. This stylus point remains sharp in contrast with the old steel needles used with lateral records, and therefore will reproduce satisfactorily undulations of sharper curvature. In other words, for the same amplitudes the linear speed of the record may be reduced.

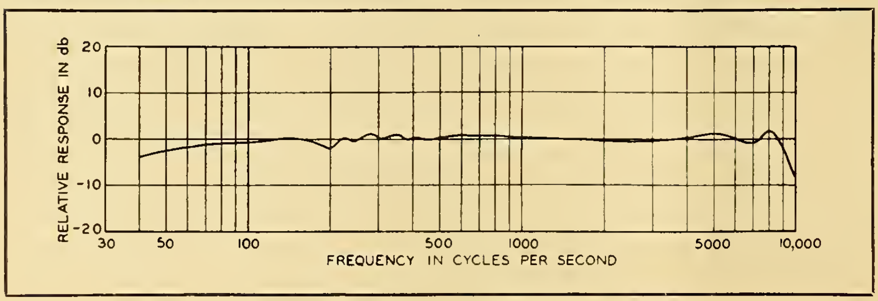


Fig. 6. Over-All Response Frequency Characteristic

Practically, it may be undesirable to reduce or change the rate of rotation of a record from the commercially used value. It is, however, feasible to decrease the internal groove diameter recorded on the 33 rpm. record to about 6 inches for a 10,000-cycle frequency range. By the combination of the various elements mentioned above, it is feasible to record for 15 to 20 minutes on a 12-inch record and for 10 to 12 minutes on a 10-inch record.

This involves the use of about 200 grooves per inch and a decrease in the recorded level to about the level of laterally recorded records using 98 grooves per inch. Of course, longer recordings can be made in the same space if the recorded level is decreased (more grooves per inch), or if the upper frequency cut-off is decreased (decreased rpm. and inner diameter). However, these changes may introduce tracking difficulties if carried too far and must be well justified by other considerations.

Effect on Reproducer

Laterally and vertically cut records drive the reproducer point quite differently. Laterally cut records drive the point from both sides but the point rarely follows the center of the groove with great exactitude. It deviates from the center by amounts chiefly dependent upon the mechanical impedance of the reproducer. A vertically cut record, on the other hand, drives in only one direction. The restoring force is due chiefly to the elasticity of the supporting structure of the reproducer, the normal restoring force being equal to the total weight on the needle minus the weight of the moving or vibrating part. The stylus point will always remain in contact with the record unless the forces set up by the undulations exceed this normal restoring force. Operation should always be below this limiting condition.

This sets definite requirements on the mechanical impedance of the vibrating parts and, unless this condition can be met, reproduction of extreme frequencies by vertical records is impossible. With the vertical reproducers which we have used, the stylus can follow sudden downward motions of the record groove even to accelerations about a thousand times that due to gravity. With laterally cut records, there is no definite limiting condition analogous to the above. However, it appears easier in practical design to reduce greatly the mechanical impedance of vertical than of lateral reproducers.

Practical experience has shown that the mass can be so reduced as to reproduce up to well above 10,000 cycles and the stiffness reduced so as to reproduce down to the order of 20 cycles. In fact, there appears to be considerable margin on this score. This makes it possible to reduce the weight with which the reproducer point bears on the record to between 2 and 20 per cent of what has been used with most commercial lateral reproducers.

This reduction in stylus or needle point pressure has been found to decrease the wear on the record very greatly, with the result that its life has been considerably increased. Tests have shown that the first few thousand playings cause negligible deterioration, and even several hundred thousand playings do not show excessive wear if the record is properly protected from dust and dirt.

A Satisfactory Method

A highly satisfactory method of providing a reproducer for vertically cut records has been to use the type of structure with which we are all familiar in loudspeaker design; namely, that in which a coil moves in a radial magnetic field. Such a reproducer is simple and sturdy. Its performance is linear over a wide amplitude range; it may be made extremely light and, at the same time, is quite efficient. The coils used have had a diameter of between 0.1 and 0.2 inch, and the total mass of the vibrating system, including the diamond or sapphire stylus, has varied with different models from 5 to 35 milligrams. The total force on the record has been reduced from about 150 grams to between 5 and 25 grams, the lighter structure being used when playing from a soft wax.

With the larger of these designs it has been found possible to obtain efficiencies which are comparable with the efficiency of the Western Electric oil-damped reproducer used with lateral records. No difficulty has been experienced due to failure to follow the groove if the reproducer is mounted on a simple pivoted arm, as in the case of lateral reproducers. Due to their very small mass they operate quite satisfactorily even though the record turntable fails to operate in a true plane, and even though the record be considerably warped.

The response of the moving coil vertical reproducer is practically constant over a very broad frequency range. It is shown in Fig. 4, which is the characteristic of an experimental model taken with cellulose acetate pressings.

The design of a recorder for use with vertically cut records involves no fundamentally new problems over those used with laterally cut records which have been described previously.[4] It is still desirable to design the recorder to approximate a constant amplitude characteristic for the lower frequency range and a constant velocity characteristic for the higher range. This frequency characteristic has been often shown and is familiar to all.

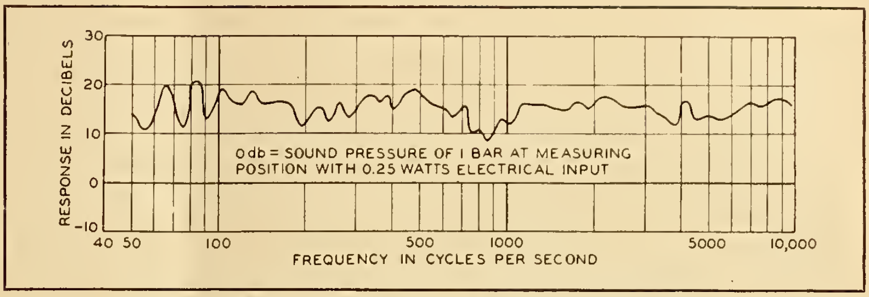


Fig. 7. Response Frequency Characteristic of Combined High and Low Frequency Loudspeakers

The same recorders which have been used for lateral recording can usually be converted for vertical recording by the addition of a comparatively simple link system and are quite satisfactory if a high frequency cut-off of 6,500 to 7,000 cycles is acceptable. It is, however, desirable to have a higher high-frequency cut-off. Such a recorder has been used in making many of the records which we have studied. Its frequency characteristic is shown in Fig. 5.

The response of the oil-damped lateral reproducer is greatest at the very low frequencies. Its response decreases with frequency, this decrease in the lower frequency range compensating more or less for the increase of response of the recorder with frequency. Because of the flat characteristic of the vertical reproducer, it has been found desirable to compensate in the reproducing amplifier or circuit for the low response of the vertical recorder at the lower end of the frequency scale. A frequency characteristic for the combination of recorder, reproducer, amplifier, and network is shown in Fig. 6.

Specific Advantages

It has been found with vertical records that speech is reproduced with considerably improved naturalness and that the word endings, sibilant sounds, *etc.*, are much more distinct. The sounds of the different instruments in an orchestra, particularly when playing a loud passage, are reproduced with very great individuality and clarity. Results of this kind are difficult to describe and should be heard to be appreciated fully.

If records such as those described are reproduced, using various low pass filters, the loss of distinctness due to the elimination of frequencies above even 7,000 cycles is easily noticeable, whereas little or no difference in needle scratch or surface noise may be observed, this being almost wholly absent in all cases. The latter statement holds whether the records contain speech or music or if blank grooves be reproduced. In listening to such records a loud speaker has been used which is essentially flat over a large portion of the range of audibility, its characteristic being as shown.[5]

The reproducer frequency characteristic, as shown in Fig. 4, is essentially flat to 10,000 cycles. A corrective network has been used which compensates for the low frequency droop in the recorder which, at the high frequency end, is, as shown in Fig. 5, essentially flat to 9,000 cycles. Thin metal-backed waxes have been used which, after recording, have been rendered electrically conducting by metal sputtering. The moving coil microphone has been used,[6] the characteristic being as shown in Fig. 8. The records have been pressed of cellulose acetate.

DISCUSSION

MR. RICHARDSON: What is an L. P. filter?

MR. FREDERICK: An L. P. or low pass filter is one that cuts out everything above the particular frequency noted, and transmits everything below this "cut-off" frequency.

PRESIDENT CRABTREE: I think I have pointed out on several occasions that the public has been satisfied to date with the reproduction of speech, but not with the reproduction of music, because of its lack of range, both frequency and volume. This demonstration has shown that the extent to which the frequency range can be covered is excellent.

I am afraid that the range of volume is still inadequate for providing a facsimile of orchestral music. But I think this demonstration shows an epoch-making advance in sound reproduction. I don't believe that I have ever heard a reproduction of a film record that is as satisfying as some of the passages we have just heard.

While I do not predict that the producers

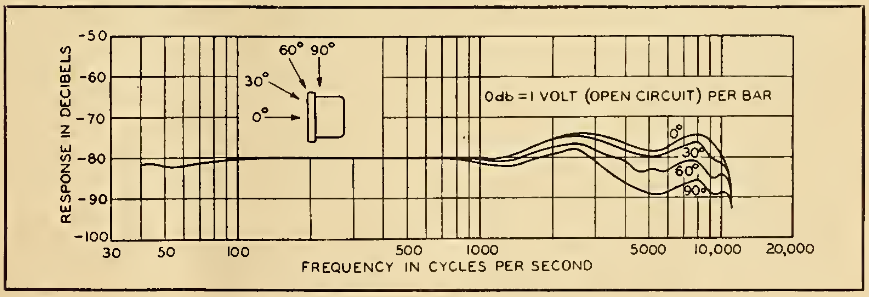


Fig. 8. Field Calibration of Moving Coil Microphone

will hasten to adopt wax records immediately, this performance will make them sit up and get busy, and either match this quality on film or turn over to the disk.

Mr. Ricker: We do not get quite the full benefit of these excellent records in this room. This room lacks in acoustical qualities for a proper appreciation of the magnificent work done.

Radio vs. Talkies

Mr. Palmer: We are always being told that the radio can produce better sound in the home than talking pictures can in the theater. Can Mr. Frederick give us any information as to whether the quality of the music reproduced here, the fidelity of reproduction, is as good as or better than what the best radio receiver can furnish?

Mr. Frederick: I hesitate to hazard an answer to that, as I am not familiar with the characteristics of all radio receivers. The reproduction of many receivers that I have heard was greatly inferior in quality to the reproduction to which we have just listened, but I prefer to let someone who knows more about that particular field attempt to answer your question.

I think you have been given a very definite picture of what those frequency characteristics mean by listening with the different filter settings. That is why we played the records with filters in and out so much of the time. One has to hear these things again and again, and even then he would have to check up his ears every once in a while, in order to have an accurate appreciation of what they are hearing.

Mr. Maxfield: Was not the reproduction level of the orchestra record as reproduced here louder than would be heard in the center of the orchestra seats in the theater where it was made? I frequently make tests in that theater, and usually sit in the center of the orchestra. My impression here at the back of the room is that the reproduction of the loud parts is louder than they appear to be in the theater, in fact, a little uncomfortably loud.

Mr. Frederick: I believe it was.

Mr. Carlton: What type of acetate was used for the new record? What method was used for the production of the cellulose acetate from which the record was made?

Mr. Frederick: I cannot tell you in great detail. It was a very pure acetate. We obtained it from various sources. Du Pont, for example, has supplied it.

Mr. Carlton: Is it molded?

Mr. Frederick: Yes, with slightly higher temperatures than are used for most other record materials.

A Matter of Taste

Mr. Hickman: I believe if the Bell Telephone Company were to present this entire outfit to an average person living in an apartment, and provide an easy means of adjusting the quality of reproduction to suit his taste, you would find that in general he would eliminate all components having a frequency greater than about thirty-five hundred. If the same person were to listen at a hole in the wall leading to an auditorium holding a good orchestra, the hole being disguised by a loud speaker design, he would tell you that the reproduction was rather good but was deficient in low frequency response.

As gramophones are getting bigger and bigger, if you produced one big enough for a man to get inside, and let him speak through a speaker aperture, the observer would tell you that it was pretty good but not quite like the human voice. There has grown up, since the reproduction of canned music, a sort of new standard of what is desirable.

Why is it that instinctively we object to what should be the more correct form of recording? I am speaking as a layman—as an enthusiastic amateur musician.

Is it possible that, when the most perfect reproduction has been made, in picking up the sound from a record a high frequency chattering is created which cannot be expressed as harmonics but as a slight disagreeable individuality imparted to the record after, say, a frequency of five thousand, which we would rather have cut out?

Mr. Frederick: I do not think that your question about reproducing these high frequencies was directed particularly to me or that you expect me to answer about the tastes of people. And I am not sure that I understand your last question.

President Crabtree: I think Mr. Hickman wants to know why the frequencies above five thousand seem to annoy one in the home.

Recently a friend commended for my radio a new speaker which had a straight curve up to I don't know how many thousand cycles. I obtained this speaker and compared it with my old speaker, which certainly does not reproduce above five thousand cycles. After repeated tests my observation was exactly the same as Mr. Hickman's—that in spite of the high frequencies, I preferred the low ones. The frequencies higher than about five thousand apparently were annoying, and seemed to irritate the ear. From this observation, it seems that straight line reproduction is not always necessary, but depends on the conditions of the room in which the reproduction occurs and on the tastes of the individual.

Mr. Hickman: I am not questioning whether the reproduction shall be linear. I am asking why, when apparently the reproduction is most faithful, we do not find the reproduction of the high frequencies pleasing. I want to know whether some particular form of high frequency distortion is introduced in the pick-up, or later on, which is not in the musical records.

H. F. Range and Distortion

Mr. Frederick: I do not think that anybody knows enough really to answer your question. And I doubt very seriously if a simple answer could be made if anyone did know enough. However, this point is extremely important. When you extend the high frequency range, if there is *any* distortion *anywhere* in the system it may be made audible and distinctly annoying, whereas it was previously inaudible. If the frequency range is to be extended upward a distinctly higher grade of performance must be obtained of all parts of any reproducing system than may seem perfectly tolerable with a lower high frequency cut-off.

The loud speakers so far designed are certainly not perfect. The curves shown in the paper indicate that by far the most jagged and roughest curve of all was that of the loud speaker. It seems reasonable to think that these irregularities, which certainly must mean a certain amount of resonance and "hanging on" of the sounds, must have an effect on the ear.

Now, if we could get a perfect loud speaker —and remember, that a perfect loud speaker means that it must be considered in conjunction with the particular room in which it is used—the results would undoubtedly be greatly modified. The characteristics of a loud speaker will be different in one room from another, and may be quite different in different parts of the same room. But placing ourselves at a particular place in a particular room, and having an ideal loud speaker to project the sound, I personally am convinced that we would, as soon as we were used to it, all vote for as broad a range as we could possibly get, and the most perfect or straight-line reproduction.

The trouble is, as we advance in our halting manner, we often make an improvement which shows up defects which were previously inaudible.

Mr. Evans: Is it not possible that the curves may not tell the complete story? The curves that we have seen are for continuous tones—single frequencies—and do not take into account transient effects that may exist. If we knew more about transients, might it not be possible to answer the questions that have been asked here?

Mr. Frederick: I think so. At least, it would take us further.

Prefers Boom-Boom

Mr. Mills: I speak not only as a layman, as some of the others have spoken, but also as one peculiarly inept in music. I have at times attended symphony concerts and orchestral renderings, and suffered from the higher and rasping violin overtones, and from irritating high frequency sounds of brass instruments and cymbals, and it may be that I prefer to listen to a little thirty-five hundred cycle cut-off loud speaker, and interpret its output as music.

But it may be that those who have a wider appreciation of music than I, and a greater discernment, would prefer the more nearly complete reproduction which includes the higher overtones.

I should like to ask Mr. Frederick whether he would briefly summarize four or five points: What is the increased range of loudness which this new record is capable of providing, over and above the previous loudness range? What is the increase in frequency range? What is the increase in time recorded under normal conditions? And what is the increase or decrease between the cellulose acetate record and the normal shellac, in ground noise, at the various frequencies which are important?

Mr. Frederick: The volume range was stated in the paper as being about twenty-five to thirty decibels for most records. I have called them shellac records. They are not simply "shellac" records, but shellac plus a lot of other technic which accompanies it. The volume range with the type of record demonstrated here lies between fifty-five and sixty decibels, according to the best data we have. The improvement is not due merely to cellulose acetate. It is due to a combination of changes. If one of three or four causes, all approximately equal, is eliminated from consideration, the improvement which will have been made in the total effect is, of course, fairly small. Our observations have led us to believe that with the old records the noise due to the shellac was somewhat greater than the other noises, but only a few decibels greater. As soon as it was reduced a little the other components of the noise came into evidence.

Regarding the time of recording, I tried to summarize this matter in the paper, but it is difficult to give any simple and definite figure to cover the entire question of playing time. On the older, lateral record, a greater number of grooves per inch was sometimes used. Something has to be sacrificed to do this, but it may be worth while. Edison put out hill and dale records which played thirty or forty minutes. They were not successful because they did not have certain other characteristics which were needed. But as far as playing time is concerned, that is something on which I don't believe you can make any simple statement.

Playing Time

President Crabtree: For a ten-inch record, how long will a lateral play and how long a vertical?

Mr. Frederick: The usual ten-inch lateral record will play three minutes, I believe, and on this type we have thought it good practice to make it play ten or twelve minutes. But if the "game is worth the candle" the time can be made longer. You have to sacrifice something else, however, to do so.

Mr. Victor: Is there a relation between frequency and volume?

Perhaps the high frequencies carry farther, and perhaps it may be possible to introduce an automatic modulator of some kind for the home that might tone down the high frequencies to a level that would be more pleasing to the ear.

Mr. Frederick: Of course it is the easiest thing in the world to get rid of them. The trouble is to get them. High frequencies, I think, are generally found not to carry in distance as well as the low frequencies. A good example of this is furnished by a man making a speech in an open space. As you walk toward him, from a distant point, you first hear the sound of his voice but cannot understand a word. As you get closer, you perceive more of the high frequencies, until, when you get close enough to get the frequencies on which his articulation depends, you can understand what he is saying. This is not simply a matter of how the various components are transmitted, but is also concerned with the fact that the lower frequencies in speech, as in music, are usually very much stronger.

President Crabtree: What Mr. Victor had in mind was a means of controlling the various frequency components, not to cut them out entirely but selectively to diminish their volume.

Mr. Victor: That is right. When a soprano voice comes over my radio I usually reduce the volume.

Mr. Frederick: If you should go to a concert to hear a first-class soprano, you would not think of doing such a thing. If you should go to hear a first-class orchestra you would not expect to do it. When we do things of that kind I believe we only try to compensate for the faults of the equipment.

Sopranos and Locomotives

Mr. Richardson: When I said that the sound was best, according to my judgment, with the seven thousand cycle components included, I did not mean that it was most pleasing, but most natural. A railway whistle, of high frequency, is annoying to everyone. But everyone rather likes to hear a steamboat whistle, which is of low frequency.

Some people enjoy a soprano, but they are the exception. But I do not believe that

(*Continued on page* 30)

A Portable Non-Intermittent Projector[*][†]

A portable projector made by the Etablissement Gaumont Franco-Film Aubert is described. The projector is of very small weight and is arranged for carrying in a case. The film moves with a constant motion past the axis of the light source and the projection lens, the image being maintained stationary upon the screen by a combination of the movement with an optical "compensator." It is claimed that due to these features wearing of the film has been very much reduced and the motion is extremely silent in operation. The article describes briefly the optical principle of the motion, how the principle is applied, and the construction and assembly of the apparatus.

THE "Simplicine" is a ciné projector for standard film, self-contained and complete, yet small enough in bulk and weight to be portable. The whole projector is enclosed in a metal casing and can be carried easily on a sling strap. Its erection is almost instantaneous and its manipulation so simple that no special experience is required for its use.

The chief importance of this machine, particularly so far as the non-professional user is concerned, is that it employs the principle of constant movement projection. The film moves with a uniform motion across the axis of the light source and the projection lens. This is a vital difference from the usual intermittent projector, in which a Maltese cross or other mechanism is used to drag the film into position and then bring it momentarily to a standstill in the gate of the machine.

In the new projector the image is kept stationary on the screen by means of a special combination of the movement with an optical device termed a "compensator." One greater advantage of such a system is the very much reduced wear on the film perforations owing to the elimination of the violent and repeated tugs to which films are subjected in ordinary types of projectors. Film is said to last five times as long when it is run in this continuous manner. To this advantage may be added the not less important one that absolutely silent mechanism can be obtained when all the moving parts are given nothing but continuous rotary movement, as is the case in the "Simplicine."

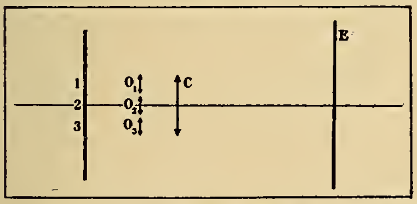


Fig. 1. *Illustrating the Optical Principle*

The Optical Principle

Fig. 1 represents a film moving in a downward direction and carrying a series of images *1, 2, 3, etc.* Imagine that in front of these images is a series of similar lenses O_1, O_2, O_3, *etc.*, each having its focal point in the plane of one of the images, and suppose this chain of lenses to move in a direction parallel with the film and at the same speed.

If the beams of parallel light so formed meet a fixed lens *C* the images of the different elements of the film will be superimposed in the focal plane of this lens. Indeed, if we consider an element formed by an image on the film and the corresponding lens, the image of a point of this element given by *C* will have its position, in the focal plane of *C*, determined solely by a straight line passing through the optical center of *C* and parallel to the straight line joining the given point in the element to the optical center of the corresponding lens.

Now this straight line as it moves remains parallel, consequently the final image is fixed. This is true for all images of the points of the element of the film. The straight lines joining corresponding points of the element to the optical centers of the corresponding lens being parallel, the images of successive elements are superimposed in the focal plane of *C*. Hence the projection screen *E* is made to take the position of the focal plane of *C* and focusing for various distances is obtained by providing a set of lenses *C* of different focal lengths.

How the Principle Is Applied

The realization of this principle in actual fact has been achieved in the following manner: The lenses are set round the periphery of a cylindrical drum *T* (Fig. 2), which is free to turn on its axis. *T* is made to rotate by the fact that the film catches a tooth *D* formed on the drum and carries *T* round with its own movement. The lenses therefore move at the same speed as the film. Light passing through the illuminated film reaches the lenses *O* after traversing a prism *P* (Fig. 2), which is formed integrally with the fixed axis of the drum. This prism has two reflecting surfaces M_1 and M_2 set perpendicular to one another.

The system thus produced is that indicated in Fig. 1, with the difference that the film and the lenses do not travel in a straight path but follow curves of the same radius. This difference has a practically negligible effect on the quality of the images, assuming that the film is illuminated only over the length of two images. This means that two images and two only of the chain of lenses are actually utilized, film elements and lenses which have any appreciable inclination to the normal being kept out of action.

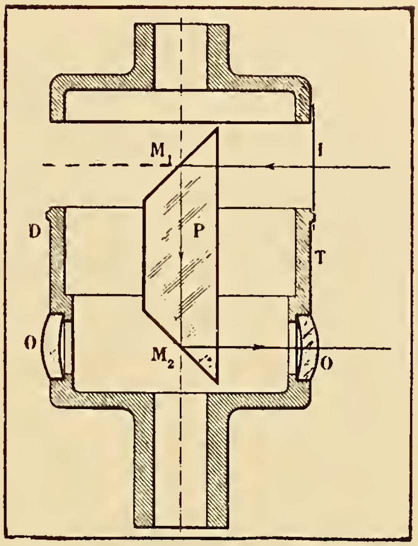


Fig. 2. *Construction of Lens Drum*

Furthermore, the projected image shows its maximum illumination at the moment at which the corresponding lens has its axis coincident with the axis of projection, and the effect of this is to reduce greatly the aberrations of the images thrown by adjacent lenses which are slightly inclined. This mechanism is exceedingly simple: it consists of a single component moving with a continuous rotary movement at low speed—80 revolutions a minute for a projection speed of 16 pictures a second. Wear is therefore reduced to a minimum and the running is quite noiseless.

The Projector Described

The "Simplicine" has been given the form of a rectangular case, the top and side of which are formed with hinged swinging sections which are raised vertically for use. All the mechanism is then made visible.

The feed-reel, *3* (Fig. 3 and 4), with its pulley, *4*, is then fixed on this raised portion of the casing. The film passes under the feed sprockets, *5*, and on to the drum *T* carrying the compensating lenses; then on to the toothed sprocket *6*, the take-up reel *7*, rotated by its drving pulley *8*.

Masking the film on the screen is effected thus: when the lever, *9*, is pressed downward, the roller, *10*, is pushed up between the two pressure rollers, thus raising the film and rais-

---

[*] Translated from *Revue d'Optique*.
[†] Courtesy of the *S. M. P. E. Journal.*

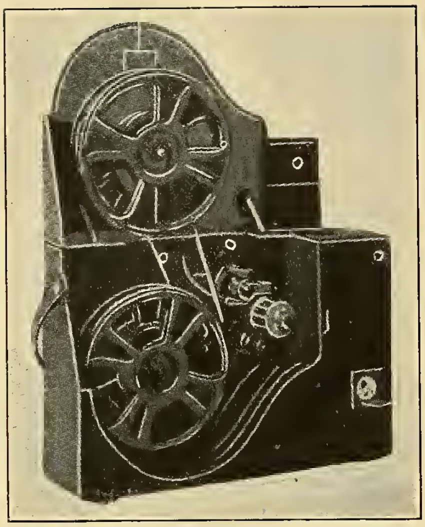


Fig. 3. Projector Opened for Use

ing the roller, *11*. If the pressure on this lever is released, the roller *11* returns into contact with the drum, and the loop formed by the film is taken up by the movement of the drum. The importance of the formation of this loop is that in this operation the film advances by one perforation. Masking is thus effected by the displacement of the image by an amount equal to a quarter of its height.

Motor Drive and Lighting

The driving parts are carried on a fixed aluminum platform and can be removed as one unit from the box. This block consists of an electric motor , *12;* a pulley drive, *13*, reversible for rewinding; and a transformer, *14*, to feed the lamp *15*. In front of this assembly, against one of the panels of the box, are mounted side by side two rheostats, for the lamp and for the motor, with finger controls, *16* and *17*, for their adjustment; and an ammeter, *19*, for the control of the lighting system. A plug let into the casing provides for the connection of the apparatus to a source of electric power.

The lamp used is a 225-watt Phillips, taking 30 amperes, at 7½ volts. The beam is of about 525 cp. in a horizontal direction perpendicular to the tungsten filament. The lamp is conical in shape and works upside down in order to avoid the blackening of the bulb around the filament. The lamp is suitably supported and adjusted. The optical system includes a two-lens condenser *25*, and spherical mirror *26* in line with the axis of the filament.

As a safety device there is a wire gauze, *27*, which is arranged to come into place automatically between the light source and the condenser when the film is stationary. This takes place by a centrifugal action. Its effect is to protect the film from any dangerous degree of heating without restricting the light unduly when the machine is used for still projection from selected pictures.

Procedure for Focusing

As regards focusing, the apparatus possesses five collimating lenses *C* (Fig. 1), arranged on a rotatable disk, and by means of these the image can be focused on a screen at any distance from 6 to 32 feet. The milled edge of this disk projects through the casing at the side so that it can be rotated by the finger, and a spring detent sets it in accurately centered position whichever lens is in action. A rectangular window in the front wall of the apparatus, made to allow the beam to pass, is fitted with two sliding covers adjustable vertically to cut off parasitic images which would otherwise be thrown on the screen.

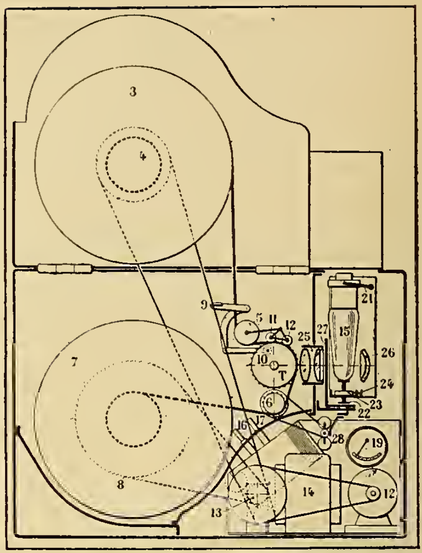


Fig. 4. Internal Arrangement

Rewinding at the end of the projection is very simply carried out. The film is released from the drum and from the guiding sprockets. An adjustment is then made, to allow the take-up reel to turn freely on its axis and to fix the feed-reel to its axis. The full take-up reel thus becomes the feed-reel, and *vice versa*. The motor, running just as in projection, then rapidly rewinds the film, leaving it ready to project again.

The Film Mutilation Problem

A Letter from Mr. Carlson on the Subject

Editor, *Motion Picture Projectionist*:

Sir: Regarding the matter of *Film Mutilation*, which you are covering with a series of articles in your magazine, wish to make a few remarks:

Most of your articles seem to be concerned more with the damage to new prints, such as processing to prevent emulsion deposit in projecting, proper tension on projectors, etc., but there is one phase of the whole matter which it seems is being overlooked, perhaps because it is not considered of enough importance, but if looked into carefully am convinced from my own experiences and observation as a projectionist, will warrant considerable inquiry and discussion.

Most of the film exchanges here in Los Angeles seem to feel that most of the damage to film is caused by improperly adjusted projection equipment, which no doubt is true to a certain extent, especially too much take-up tension while the first reel in each machine is run at the beginning of daily run, which can be overcome by anchoring an empty reel in the lower magazine while warming up the machine and thus save the first several hundred feet of the first reel of the day's run from having to perform this duty. Notice the leader and front end of most features and notice patches, etc., if the print has been used for any length of time. The succeeding reels of a feature are in much better shape than the first and third in practically every feature the writer has built up (most of the film run in the theatre where the writer operates has been used for considerable time).

All of the above, while having considerable bearing on the matter of film mutilation, is of relatively less importance on the matter than is the damage to film caused in handling, transporting, shipping, etc.

In tearing down shows, if the film is wound smoothly and evenly with no overlapping edges very little damage will result from kicking the containers around like footballs, which is the treatment it receives at the hands of delivery men (believe it or not), but what will happen, I ask you, if your projectionist in his hurry to tear down the show uses a hand rewind and does not guide the film so it will wind smoothly on the reels? The containers are then slam-banged around on their merry way back to the exchange, and if the container happens to be one of the variety in which the reels lie on their sides, can you imagine what happens to the film?

There is one exchange here in Los Angeles which uses practically no other kind of a can but this lay-flat type and their film on all prints which have been used for any length of time at all is in a deplorable condition. Recently ran a feature which less than two months before had its first run in the city, in which I counted sixty-five patches in the first two hundred feet of one of its reels. For the past year have paid particular attention to the type of can in which the film was received and unless the film was practically new it was in far worse shape when received in lay-flat cans than when received in on-edge cans.—*Charles G. Carlson, Los Angeles, Cal.*

Television—Its History and Future

By AUSTIN C. LESCARBOURA

As we observe or read of the remarkable advances which have been made in the television field in the past few years, we are apt to overlook the fact that this science like many other of our amazing technical achievements of modern times has a tangible and substantial background. It is only through an appreciation of the obstacles which have already been overcome that one can arrive at a realization of what may be expected in the way of future accomplishment. In the article which follows the author presents some of the highlights of television history and describes certain of the problems which have been met and others which are still confronting the field. Mr. Lescarboura has attained an eminent and authoritative position as a writer on radio and television subjects and his statements are always deserving of thoughtful consideration.—THE EDITOR.

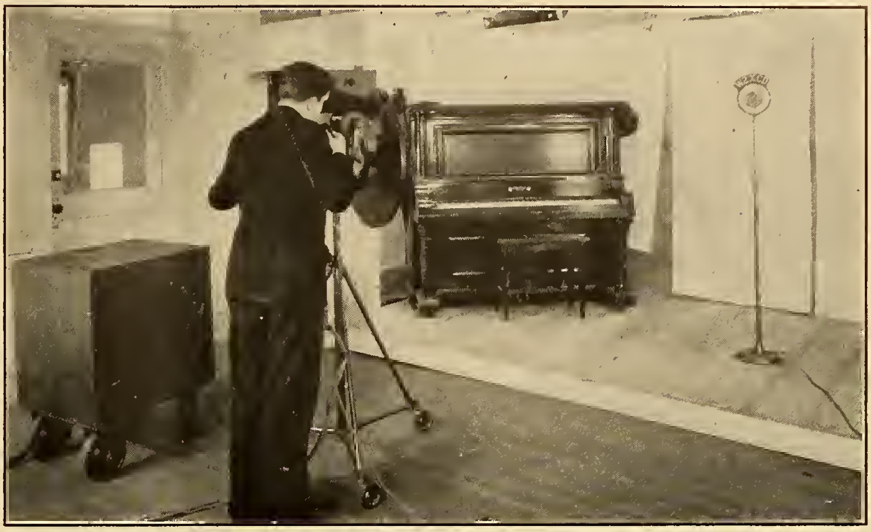


Fig. 1. Television Studio Set-Up (DeForest Station W2XCD)

BEFORE the electric light, before the automobile, before the aeroplane, before radio, Paul Nipkow, an obscure German experimenter, applied for a patent on an "electrical telescope." The patent specification, No. 30,105, still available at the German patent office, not only anticipated the method to be used in television broadcasting but actually prescribed, except for a few modern refinements, precisely the equipment to be used. The year was 1884.

Nipkow and Hallwack

Essentially, Nipkow knew what had to be done to procure television pictures. Unfortunately, some of the devices used today to do it were at the time lacking. Four years after Nipkow's patent Hallwack observed that certain metals when exposed to light shoot off electrons, actual particles of electric current. Later experimenters found the effect to be enhanced when the light-sensitive metals were enclosed in glass bulbs from which the air had been evacuated. Thus was developed the photo-electric or light-sensitive cell, sometimes referred to as the electric eye.

The invention of the radio vacuum tube by Lee De Forest in 1906 and all that this invention presaged by way of vacuum tube amplifiers furnished another important tool for the modeling of television pictures. Thirdly, the development of the neon lamp gave to television workers the final important device lacking to Nipkow and his immediate followers. We might say then that television, though conceived in 1884, made little actual progress until the beginning of the second decade of the nineteenth century, because not until then had experimenters recourse to the three most important tools necessary for advancement—the photo-electric cell, the vacuum tube and the neon lamp.

In 1911 Charles Francis Jenkins, who had some years before invented the first practical motion picture projector for theater use, turned his attention to television. He invented many television applications and devices, obtained more than 400 patents, and in 1925 considered his work sufficiently advanced to give a demonstration. The success of the demonstration, in which he broadcast a strip of motion picture film by radio, led to the formation of the Jenkins Television Laboratories in Washington, D. C. Jenkins distributed at cost thousands of cheap television receiver kits to enthusiastic amateurs throughout the country, thus obtaining a force of field workers to cooperate in calling to his attention the problems encountered in practical extra-laboratory television broadcasting.

Recent Developments

In the meantime many other workers both here and abroad were experimenting with television, notably John L. Baird in England, Herbert Ives, of the Bell Laboratories, and E. F. W. Alexanderson, of the General Electric Laboratories in Schenectady. While these and other workers devoted their efforts to the development of television on the basis of the scanning system suggested by Nipkow and designed by Jenkins, the cathode ray method of transmitting and receiving television images was being considered by Zworkin and others. Television became specialized, various workers concentrating on various methods and systems. More recently other names have come to the fore; Replogle, of the Jenkins Television Corporation, which bought out the Jenkins patents and has developed television along the lines he pioneered, Sanabria of Chicago, who has projected large images on screens, Hollis Baird of Boston—not to be confused with the Baird of England—who is merchandising television receivers through the Kresge stores, and Farnsworth of California, who claims to have a system whereby many more television stations may broadcast than now on any given span of wavelengths.

Television Stations

The Federal Radio Commission, realizing the importance of television, set aside the 100-150 meter band for the use of television stations. Jenkins' W3XK was one of the first television stations on the air. Others were quick to join. History repeated itself but in more orderly fashion. When radio or sound broadcasting started many people thought to make huge profits by the establishment of stations and crowded the air with transmitters. Few of these knew anything about radio or were in a position to aid the development of the science.

The Federal Radio Commission, faced with the same problem in television, has wisely licensed only such broadcasters as have shown the ability to contribute to the art by past performance and the likelihood of continuing their developments as manifested in present research. As a result we now find 21 television stations on the air.

In addition, many other would-be broadcasters have been refused licenses. The excellent regulation of television broadcasting activities by the Commission, in contrast with the haphazard growth of radio broadcasting, assures broadcasters and audiences alike that the air will not be overcrowded, that stations will not operate on channels so close to each other as to cause interference, that stations will keep to their assigned channels and that the present broadcasters, having been licensed for their ability to transmit the finest pictures now possible, will give the public their best and actively improve that best.

The question arises at this point, how good are television pictures? The question cannot be answered with such comparative terms as excellent, good, fair, poor. These depend for their meaning on interpretation and the expectancy of the observer. The quality of television is limited by two factors, the scientific and the artistic.

Scientific Limitations

Although scientific progress has been great, perfection is far from achieved. But whereas lack of fundamental knowledge and basic principles in the past delayed progress and made necessary resorting to the laborious trial and error method, from now on efforts will be exerted toward refinements rather than radical innovations, and we may expect to see longer strides in one year than in the past five.

Still, the limitations of the photoelectric cell and the scanning disc are not to be ignored. The problem has been aggravated by lack of finances. The Federal Radio Commission has as yet granted no commercial television licenses, only experimental ones. Television stations are forbidden to accept money from sponsors. The consequent lack of funds often necessitates the use for experiments of equipment that should be kept standing for daily programs. However, the increasing sale of television receivers and the association of television stations with commercial radio broadcasters who are allowed to accept sponsors is tending toward the acquisition of sufficient funds to maintain separate apparatus for purely experimental purposes.

The photo-electric cell, though a phenomenal instrument, is not as sensitive as the modern motion picture film. The fine nuances of light and shade found in the modern film are lacking in television. But they were not always present in motion pictures either. In time the photo-electric cell will be able to handle the same values as the film does today.

The scanning disc brings with it several problems. Aside from the disc all the other processes of television are electrical, in contrast with which the mechanical scanner seems crude. On the other hand, the cathode ray method of television transmission and reception has certain inherent handicaps, including high cost and short life. However, scanning is constantly being improved, the number of holes being increased as well as the speed of revolution of the disc. Thus whereas a short time ago a 48-line 15 frames per second picture was standard, today the lines have been increased to 60 and the speed to 20 frames, giving in effect a more solid image. Still, the picture is definitely made up of horizontal lines. By increasing the number of lines and the speed of the disc solidity will eventually be obtained.

Artistic Limitations

Artistically television programs are almost non-existent. The financial reason is obvious. For many years a television organization consisted entirely of engineers concerned with technical problems. Only recently were these problems solved to an extent warranting the attempt to broadcast pictures of entertainment value. Before this the pictures were for engineering observation only. The lack of finances and an audience precluded the employment of showmen as part and parcel of the television organization. Now, however, that condition is slowly being rectified. On the other hand, the lack of any set television technique prohibits the broadcasting of superlative programs, even when handled by professionals. The present status of the science is such that a technique has to be acquired, then the best use of that technique learned.

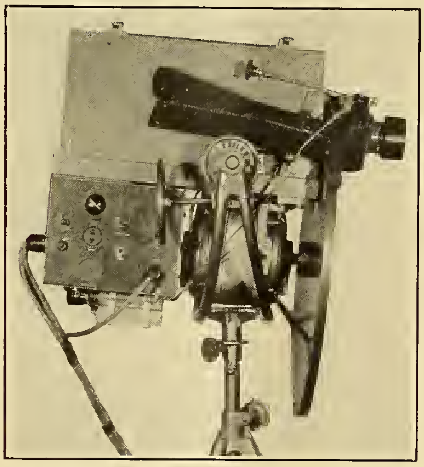


Fig. 2. Jenkins Direct Pick-up Camera

Future Possibilities

Television programs of some merit have been presented. The technique, often the material, has been borrowed from other fields, the dance, the theater, the motion picture, the concert stage. The potentialities of television, the advantages of this medium over any other, have been most forcefully brought out perhaps in costume performance incorporating the dance, plays, songs and pantomime. For television, linked with radio, though it lacks the human touch of a flesh and blood performance, is potentially the most perfect medium of synthetic entertainment.

Importance of Sound

The importance of sound accompaniment to the television program is not to be overlooked. In the first place, sound is psychologically essential. The motion picture industry realized this very clearly in its career, and every motion picture of the silent era had its musical accompaniment, even though it consisted only of an untuned and battered piano played by a sleepy-eyed pounder of the keys. Since the advent of specially written scores and talkies in which the sound is made to suit the picture, audiences will no longer accept visual entertainment without sound.

Moreover, the virtual perfection of radio and the imperfection of television make sound most advisable, since on it will be placed most of the burden of sustaining interest. Sound will carry the meaning and continuity of the picture, making more distinct the less perfect television image. The ability of linking television with radio leaves no excuse for not accompanying the picture with sound, in the form of dialogue, incidental music when showing motion picture films, singing, instrumental music for dancing and the like.

The Perfect Performance

From the foregoing it is evident that the perfect television performance is going to be much more elaborate and costly as well as more satisfactory from an artistic and entertainment angle than is radio broadcasting.

The development of programs is the next vital move in the growth of television. Not that the technical end has attained perfection. Far from it. But it has progressed to that point where public interest must be enlisted and this can be done only through presenting entertaining features. Also, the revenue for future research must come in part from the sale of receivers to the public, dependent on acceptable programs; and on money from sponsors, again dependent on programs. Television has arrived at a turning point. In the past it was entirely an engineering proposition. Now showmanship must step in to make valuable the potentialities already developed by the engineers.

Local 156 Elects Officers

At a recent election held by Local 156 of Danville, Illinois, the following officers were chosen for the new year: President, Fern Fielding; Vice-President, George Hamer; Secretary and Treasurer, Arthur M. Kellogg; Recording Secretary, Ercell C. Maiden; Business Agent, Guy Hutton, and Sergeant-at-arms, John Watts.

Slit Losses in Sound Optical Systems

By ALBERT PREISMAN

As the author states in his opening paragraph, an attempt is made in the article which follows to lift the veil of mystery from the sound head optical system. There can be no doubt but that there is much about the optical system which may be more clearly understood if treated in a simple and logical manner. Mr. Preisman has seen considerable service in the field of technical teaching, and is an electrical engineer of wide experience. He is a graduate of Columbia University.
—THE EDITOR.

TO the average projectionist, one of the greatest mysteries in sound reproducing equipment is the optical system. The need of a fine light slit and its effect upon sound reproduction, is appreciated, but the reasons therefore are in general unknown to him. It is the aim of this article to lift the veil of mystery from this part of the apparatus and reveal its functioning so that he who "runs" may read.

As has been mentioned so often before, sound is a vibration of a medium (usually air) of such frequency as to be capable of affecting the ear and causing the sensation of sound in the brain. A note of high pitch differs from one of low pitch in that its frequency is higher. This means that the molecules of air in the first case vibrate back and forth more times per second than in the second case.

Recording the Sound

In recording, these air molecules are allowed to impinge upon the diaphragm of a microphone, and cause this diaphragm to vibrate at the same frequency (or frequencies—if the air molecules vibrate at more than one frequency at the same time) as they, themselves, are vibrating. The microphone, in turn, causes a variation in an electric current of the same frequency as the air molecules. This current is very minute, so it is amplified by an amplifier, and a magnified replica of the original current is obtained. The latter is now passed into an oscillograph recorder. The latter is really a tiny electric motor, whose movable element vibrates like the piston of a steam engine, rather than rotates, when the oscillating or varying current is passed through it.

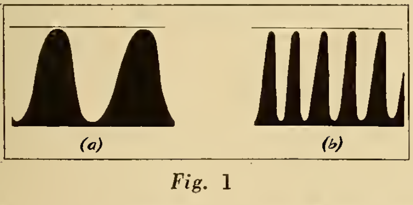

(a) (b)

Fig. 1

In this discussion we shall consider variable area recording, because the exposition is simpler. The same considerations, however, apply to the variable density recording, too.

When the variable, amplified current is applied to the oscillograph recorder, a little mirror in it is caused to vibrate in exactly the same manner and at the same frequency as the air molecules originally impinging upon the microphone. A beam of light is reflected from the mirror into an optical system which shapes this beam into the form of a fine slit on the sound track of the recording film. As the mirror vibrates, this beam of light is caused to sweep back and forth across the sound track—at the same frequency as that of the mirror, and hence of the air molecules,—and so finally we record, on the sound track of the film, in the form of a kind of saw tooth, a picture of the motion of the air molecules. (See Figure 1 a and b).

Width of Frequency Peaks

If the frequency of vibration is low (low note) the saw teeth will be drawn out as in "a", while if the frequency is high (high pitched note), the saw teeth will be fine and compressed, as in "b". We can show this effect by simple arithmetic. The film speed is 90 feet per *minute* so that 18 inches of film per *second* pass by the light slit. Suppose we have a 100 cycle note. The light slit vibrates 100 times across the sound track in one second. In that time 18 inches of film pass by. Therefore, each peak and valley (one complete vibration) must occupy 18"÷100=0.18", or the peak occupies one-half of this distance, or 0.09", and likewise the valley occupies the remaining 0.09" of the 0.18" allotted to the two.

But, if the frequency is 5,000 cycles per second, the width of a peak and valley is only 18"÷5,000=0.0036", or that of a peak or valley is 0.0018".

If such narrow peaks are to be photographed on the sound track and are to be spaced by valleys equally narrow, it is evident that the light producing these must be equally narrow. Consequently light slits one thousandth of an inch in width, or even less, are used.

The requirements here are exactly the same as for disc recording. In this case, the cutting tool must have a very fine point in order to be able to trace out the very fine waves in the record groove to represent the higher frequencies.

When we come to sound reproduction, exactly the same considerations hold. A fine slit of light is focussed on the sound track. As the film passes by, the dark opaque peaks obliterate the light slit, and then the valleys allow the light to shine through. In order that even the finest peaks (representing the highest frequencies) be able to obliterate the light slit, it is necessary that the latter be fine enough for them to do so. Hence here too, in reproduction, a narrow light slit must be used.

The same holds, as before, for disc reproduction. A fine needle point must be used in order that it be able to follow even the finest quirks in the record groove.

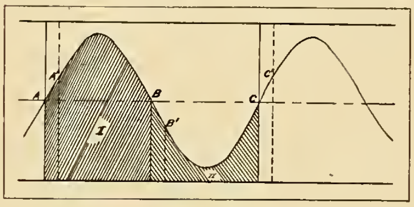


Fig. 2

At this point it is desirable to call the reader's attention to the fact that it is not the light shining on the photocell that produces sound from the loudspeakers, but the *variation* in the light impinging upon the photo-cell. Hence, as will be indicated, if the light slit is of such a width that as the peaks and valleys pass by, they cause no variation in its intensity, no sound will result from the speakers.

Varying the Light

We shall now proceed to show this. Although ordinary sounds are very complex, and consist of many frequencies occurring at the same time, nevertheless it has been shown elsewhere that any such complex tone may be resolved into its constituent frequencies, and the effect of each on a system studied separately and independently. Hence we shall consider in the following argument only one frequency, represented by a curve known mathematically as a sine wave, and study its effect upon the light slit. In the case of a complex tone, the effect of each constituent frequency upon the light slit could be studied, and the total effect would be the sum of the individual effects.

Let AA'BB'CC', Figure 2, represent the sine wave, and the cross hatching the dark portion of the track. Suppose the light slit of width AC, that is, it is as wide as a peak and valley combined. Half of the slit is blocked out by Area I (shown by cross-hatching to the left), while the other half is blocked out by the smaller Area II under the valley (cross-hatching to the right). The difference between Area I and Area II represents the maxi-

(*Continued on page* 29)

Theory and Fundamentals

By W. W. JONES

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Engineering Department of RCA Photophone and has been closely identified with the educational activities of that organization since the time of its inception. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that institution.—THE EDITOR.

Some Facts Concerning Film Drive Sprockets (Cont.)

IN last month's issue of this magazine our department was devoted to the consideration of feed sprockets. We now take up the discussion of hold-back sprockets. For the sake of clarity it may be well at this point to repeat the definitions applying to these two main sprocket classifications as furnished in our preceding article on the subject:

"For purposes of this discussion, sprockets as used in picture projectors and sound reproducers are classified under two main divisions, viz.: (1) Feed Sprockets, and (2) Hold-back Sprockets.

"The first division, feed sprockets, may, from the point of view of operation, be classified further as follows: (1) The upper feed sprocket—used to pull the film from the upper magazine and feed it into a loop just ahead of the picture gate, (2) The intermittent sprocket—used to pull the film through the picture gate and feed it into a loop just ahead of the lower take-up sprocket, and (3) The sound sprocket (often called constant speed sprocket)—used to pull the film through the sound gate or trap.

The Hold-back Sprocket

"The second division, hold-back sprockets, when applied to sound and picture projection equipment, may be sub-divided as follows: (1) Lower hold-back sprocket—used as the last drive sprocket in the projector to hold the film back and maintain a loop of film between itself and the intermittent sprocket to prevent damage to the film, and (2) The Lower take-up sprocket—used as the last sprocket in the sound reproducer to hold back the film from the pull exerted by the lower take-up reel, and to maintain a loop of film between itself and the sound sprocket to prevent interference with the sound."

The hold-back sprocket is primarily intended to maintain a free loop of film in the film path just ahead of itself. For example, the hold-back sprocket (commonly called the take-up) is located in a projector just ahead of the take-up magazine, and its purpose is to maintain a loop of film between itself and the intermittent sprocket, so as to prevent damage to the film caused by the intermittent film drive at the intermittent.

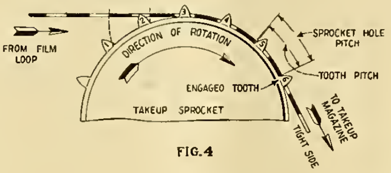


FIG. 4

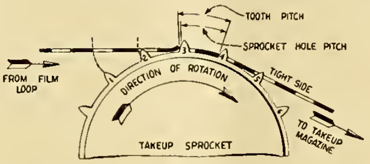


FIG. 5

Further, the hold-back sprocket in a sound attachment is intended to maintain a loop of film between itself and the constant speed sprocket, which will prevent the uneven pull exerted by the take-up drive from interfering with the uniform speed drive at the sound sprocket.

Design Considerations

In the design of a hold-back sprocket it is not necesary to consider the question of uniform speed of film. It is necessary to consider only those factors which will affect the life of the film driven by the hold-back sprocket. Ordinarily for maximum film life, precision work in the manufacture of a hold-back sprocket is just as important as in the manufacture of a feed sprocket. That is, the shape of the sprocket teeth should be uniform, and each succeeding tooth pitch should be equal within very close limits. One of the most important considerations of a hold-back sprocket is that of diameter.

In operation it is possible to have a hold-back, because of variation in diameters, operating under the following three conditions: (1) An ideal condition wherein the sprocket hole pitch is equal to the tooth pitch, (2) A condition wherein the tooth pitch is smaller or less than the sprocket hole pitch as illustrated in Figure 4, and (3) a condition wherein the tooth pitch is greater than the sprocket hole pitch. The effect of operating a sprocket under these conditions will be discussed in the following:

In the discussion of the ideal feed sprocket, it was pointed out that its diameter should be such that its tooth pitch is equal to the sprocket hole pitch of the film. The same statement holds true for the hold-back sprocket. From this it can be said that for a given film the ideal hold-back sprocket is identical in diameter or tooth pitch with the ideal feed sprocket. However, in practice it is necessary to drive film of which no two lengths have the same shrinkage, or, stated differently, no two lengths of film have the same sprocket hole pitch. Since the sprocket hole pitch varies from film to film, it would be impossible to use an ideal sprocket, thus making the ideal sprocket only a subject for discussion.

From previous discussions it has also been pointed out that the practical feed-sprocket tooth pitch was made equal to the sprocket hole pitch of new or unshrunk film. In the case of the practical hold-back sprocket, the tooth pitch is made equal to the sprocket hole pitch of maximum shrunk film. The feed-sprocket always operates with film which has a smaller sprocket hole pitch than its tooth pitch, and the hold-back sprocket always operates with film which has a sprocket hole pitch greater than its tooth pitch as shown in Figure 4.

Figure 4 shows a take-up or hold-back sprocket which is receiving film from a film loop, and is feeding it to a take-up magazine which is exerting a pull on the film. It is to be noted that the tooth pitch is smaller than the sprocket hole pitch. It is to be noted further, that only one tooth is engaged (No. 6), and this tooth is engaged with the trailing or lagging edge of the sprocket hole.

Operation of Hold-back Sprocket

In operation the film becomes disengaged with tooth No. 6 during the stripping process, and at the same time the film slips ahead on the periphery of the sprocket until tooth No. 5 becomes engaged. Thus the stripping and slipping process repeats itself for each tooth. Since uniform film velocity at the take-up sprocket is not important, no attempt has been made, as in the case of the feed sprocket, to adjust the shape of the teeth in order to reduce the effect of film slippage. However, for the sake of uniformity the tooth shape of all sprockets is made alike.

By further reference to Figure 4, it will be noted four teeth are included within the film wrap on the sprocket. The film wrap in this particular diagram could be increased to include tooth No. 2. However, if the film wrap were increased to include tooth No. 1, the leading edge of the sprocket hole would strike the face of tooth No. 1 as shown by the dotted circular involute curve, and damage film. If in operation it is found that the hold-back sprocket is tearing the leading edge of sprocket holes, the trouble can be remedied by reducing the wrap or by stripping the film from the sprocket sooner. The amount of wrap possible on a given hold-back sprocket increases with shrunken film.

Another Condition

Figure 5 shows a hold-back sprocket in operation with film in which the tooth pitch is greater than the sprocket hole pitch. This figure represents a condition in which the tooth pitch of the sprocket is too large or is made greater than the sprocket hole pitch for maximum shrinkage. It will be noted that the film is engaged at tooth No. 4, and the trailing or lagging edge of the sprocket hole is buckled at tooth No. 3. It will be similarly noted by the circular involute curves that the buckling effect at tooth No. 2 will be twice as great as at No. 3, and three times as great at No. 1. To operate a sprocket under these conditions obviously will result in damaged film. If the lagging edge of sprocket holes is being torn in operation by the hold-back sprocket, there is no remedy except to replace the sprocket with one of smaller or proper diameter.

Summary

The following is a brief summary of the conclusions contained in the above discussion on the hold-back sprocket, and in the discussion on the feed-sprocket which appeared in the February issue of MOTION PICTURE PROJECTIONIST.

1. The tooth pitches of an ideal feed-sprocket and of an ideal hold-back sprocket are the same and equal to the sprocket hole pitch of the film with which they are to operate. However, no two films have the same sprocket hole pitch, therefore, ideal sprockets are not manufactured.

2. The tooth pitch of a practical feed-sprocket is made equal to the sprocket hole pitch of new or unshrunk film. The tooth pitch of a practical hold-back sprocket is made equal to the sprocket hole pitch of maximum shrunk film.

3. A practical feed sprocket always operates with film having a sprocket hole pitch equal to, or less than, its tooth pitch. A practical hold-back sprocket always operates with film having a sprocket hole pitch equal to or greater than its tooth pitch.

4. The tooth shape of a feed-sprocket, particularly of the constant speed sprocket, is made to recede more rapidly than the circular involute (See Figure 1) in order to reduce the film slippage effect on the periphery of the sprocket each time a tooth disengages. The tooth shape of a hold-back sprocket is not designed to reduce film slippage; however, the tooth shape usually is made similar to that of a feed sprocket for sake of uniformity.

5. The tooth base thickness of a feed-sprocket is reduced sufficiently to operate without interference with maximum film wrap and with film having maximum shrinkage. The tooth base thickness of a hold-back sprocket is reduced sufficiently to operate with maximum film wrap, and with new or unshrunk film.

6. A feed sprocket cannot be used successfully as a hold-back sprocket without damage to film. Likewise, a hold-back sprocket cannot be used as a feed sprocket.

Screen Brightness Survey Scheduled for N. Y. Houses

A sub-committee consisting of J. J. Hopkins, F. H. Richardson, S. Glauber and P. A. McGuire has been appointed by the Society of Motion Picture Engineers to make an elaborate study of screen brightness. The committee will conduct a series of tests in New York theatres to determine what the actual existing conditions are as regards screen brightness and to determine what values of screen brightness are conducive to good projection.

There has been a great need for such a study, according to officials of the Society, and, since little accurate data are available on the subject, it is believed that the results of the survey will prove of value to the industry. The purpose of the study is to determine a suitable value of brightness which may be recommended to the Standards Committee of the Society of Motion Picture Engineers as representing good practice, compatible with high quality projection.

This committee is a sub-committee of the Projection Practice Committee, headed by Mr. H. Rubin as chairman, which committee is making an extensive study of all important factors upon which good projection depends. The study involves measurements of the reflection characteristics of screens, the average densities of the films to be projected, physiological effects on the audience, and many other quantities.

The S.M.P.E. Standards, Projection Theory, and Projection Screens Committees are collaborating in this work.

Question and Answer Dept.

Conducted by W. W. JONES

NOTE: *Readers are invited to send in their questions pertaining to technical subjects to Mr. Jones in care of this magazine. Questions should be typewritten if possible and one side of the paper must be used. All enquiries must bear names and addresses, but initials only will be published if requested. Questions will be answered in the order in which they are received.*

Question: How would one set about synchronizing two three-phase projector motors so that when the two machines are threaded at the start of the reel they will run in synchronism, frame for frame, or will operate as what I understand is termed "interlocked"?—*Paul C. Brown, Hollywood, Cal.*

Answer: To the best of my knowledge there is no method whereby two synchronous motors may be started in step. However, synchronous motors have been and are used in preview rooms successfully, by threading a picture print in one projector and a sound print in the other projector. If the two projectors do not have the same starting time the projectionist allows a few frames of film on one of the projectors to compensate for difference in starting time. Once the motors have attained synchronous speed they will operate in step thereafter.

For your information, the General Electric Co. manufactures an interlocking drive system which will operate in a fashion described by you. The system consists of as many Selsyn drive motors as is necessary, and a Selsyn master unit.

For recording or projection work the Selsyn motor has a 3-phase stator and a 3-phase wound rotor. The Selsyn master consist of a 3-phase generator with a 3-phase wound rotor, and this generator is on a common shaft with a 3-phase synchronous motor.

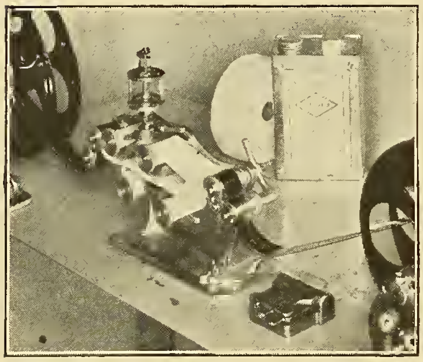
In operation the stator windings of the Selsyn motors and the master generator are connected in parallel and excited by a common 3-phase power source. The rotor windings of the Selsyn motors and the master generator are also paralleled but are not excited externally. Briefly, when the equipment is so connected all motors will be locked in step with the master generator, and if the master generator is at rest all the motors will be at rest. If the master generator is turned a quarter turn all motors will rotate a quarter turn. Likewise, if the master generator is operated at a given speed all motors will operate at the same speed and in step. It is common practice to have the synchronous drive motor of the Master Unit operate at 1200 r.p.m., thus operating all Selsyn motors at 1200 r.p.m.

New Equipment and Appliances

Film Cleaner Combination

A COMBINATION wiper-cleaner for motion picture film, so designed that it may be mounted on the rewind bench and available for ready use, has been placed on the market by the Film Processing Machinery Corp. of New York.

The combination, together with a special cleaning fluid manufactured by the same concern, removes the oil and dirt which collects on motion picture film. It is said that the method contributes greatly to the elimination of the risk of clogging the aperture in the sound gate and thus assures a properly modulated sound effect instead of that harsh and irritating noise, which is the result of neglected film.



Convention to Stress Many M. P. Problems

Problems confronting the industry in regard to release prints and theatre operating practices will receive special consideration during the meeting of the Society of Motion Picture Engineers to be held in Washington, D. C., May 9-12. Another session will be devoted to photographic problems, according to O. M. Glunt, Chairman of the Papers Committee.

It is believed by the Society that the poor quality of release prints has complicated the work of the projectionist and has affected theatre attendance and the Papers Committee plans to secure the best authorities in the industry to present papers on this general subject. Leaders in theatre operation will also be secured to deliver papers before the session on theatre operating practices.

A number of changes have been tentatively planned for the meeting this year. There will be no business sessions on the opening morning of the convention, this being reserved for registration and organization work. On Monday afternoon attention will be given to the business of the Society and committee reports. The session of theatre operating practices will be held Tuesday afternoon. A session will be held Wednesday morning at the Department of Commerce where a number of talks will be given by Government officials. A visit to the White House is being planned for Wednesday afternoon.

The Thursday morning session will be confined to the problems of release prints. The photographic session will be held Thursday afternoon. For the evening sessions, it is planned to show previews of motion pictures Monday and Tuesday evenings. A session will also be held Tuesday evening at the Bureau of Standards. The semi-annual banquet will be held Wednesday evening in the Gold Room of the Wardman-Park Hotel.

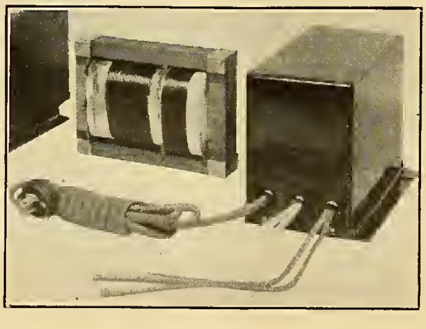
Many entertainment features have been arranged for members attending the meeting. The Congressional Country Club and the Indian Spring Country Club will be available for members who wish to play golf. Tennis courts are available at the hotel. Sightseeing tours are being arranged for those who wish to see the many historic sites in and around the Capital. The convention occurs during the height of the Washington Bi-centennial, which will be one of the greatest events during 1932.

"No effort is being spared to make this the greatest convention yet held by the Society," according to W. C. Kunzmann, Chairman of the Convention Committee, and N. D. Golden, Chairman of the Local Arrangements Committee.

Voltage Regulator For Photo-cell Devices

Photo-cell apparatus is very critical to voltage variations. Due to the rapidly increasing demand for their Constant Wattage Voltage Regulator for eliminating the distortion and inaccuracies of photo-cell devices resulting from voltage fluctuation, the Ward Leonard Electric Company has just issued Bulletin 5501. This covers a line of regulators for unity power factor loads from 10 to 100 watts.

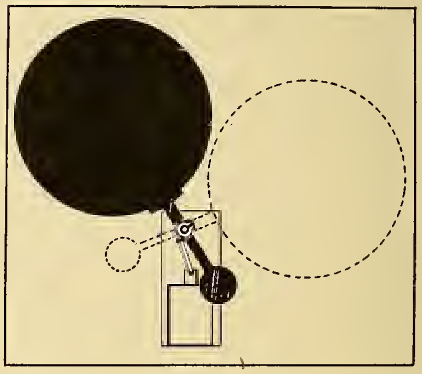
The Ward Leonard Constant Wattage Voltage Regulator is a voltage transformer and regulator combined, reducing the A.C. line voltage to that required by the exciter lamp, and maintaining the exciter lamp voltage constant regardless of instantaneous fluctuations in line voltage. The design of the regulator is such as to compensate for variations in lamps of the same nominal rating and to correct for the increase in lamp resistance with aging. This assures a constant light source intensity with the resultant accuracy and precision of operation of the photo-cell device.



Remote Controlled Spotlight Black-Out Shutter

A NEW remotely controlled black-out shutter, which it is reported is effectively meeting the demand for a device of this nature, has been recently placed on the market by Kliegl Brothers of New York.

The shutter is operated by means of an electro-magnet controlled from the theatre switchboard or other remote point, and provides facilities for the instantaneous and simultaneous control of the light beam of every spotlight in the theatre. By inserting a disc into the light beam a quick elimination of light is obtained, leaving the arc lamp or bulb at full intensity and ready for instant use as soon as the black-out is over. This arrangement avoids that slow-dying red glow from the light source when the current is turned off.



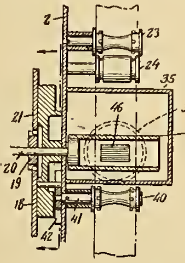
By centralizing the control on the switchboard, either in groups or under one switch, they increase the effectiveness and precision of the black-out.

The shutter is self-contained and may be attached to any spotlight. In the case of balcony spots, the shutters may be mounted on the inside front balcony wall so as to shut off the openings provided for the light rays. In this case the fronts of the shutters are painted the same color as the balcony front, adding to its beauty.

RECENT PATENTS

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 230 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine, and enclosing fifteen cents to cover costs.

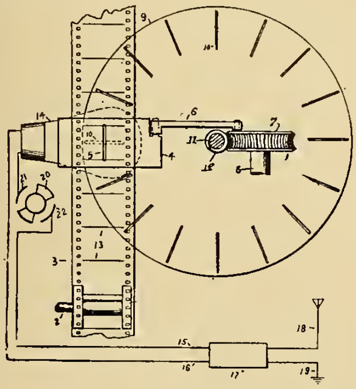
1,839,315. MOVING PICTURE PROJECTOR. HARRY HOOVER, New York, N. Y., assignor to Abe Maskow, New York, N. Y. Filed Apr. 26, 1928. Serial No. 273,014. 2 Claims. (Cl. 88—19.3.)



1. In a moving picture projector, a source of illumination, a gate through which film is fed, a shutter comprising a transparent glass tube located between the source of illumination and the gate whereby the intensity of heat rays on the film is diminished, an opaque spot of sufficient area and suitably positioned to obscure the film in the gate during movement of same on said tube, means for rotating said tube and means for intermittently moving film through the gate in synchronism with the shutter.

▲

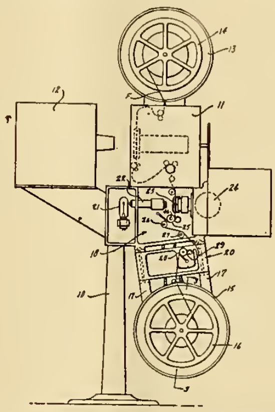
1,842,759. TRANSMISSION OF MOTION PICTURES AND THE LIKE. WILLIAM MALM, New Orleans, La. Filed Aug. 22, 1927. Serial No. 214,753. 7 Claims. (Cl. 178—7.)



1. The combination with a radio transmitting device and a motion picture film actuating device, of means for exploring images of moving objects on said film in parallel linearly-aligned groups of component parts of definite areas, in vertical unidirectional paths, successively adjacent from left to right, then from right to left, and then from left to right again, etc.; comprising a horizontally reciprocating opaque structure having a vertical slot of definite size, and operating in conjunction with a revolving opaque structure having a plurality of equidistant radial slots of definite size, and a light responsive device which reacts with light rays passing thru said film and successive cross points of said vertical slot and each of said radial slots, and relays corresponding electrical impulses to said radio transmitting device, a rotary electric switch driven by said film actuating device, and controlling impulses from said light responsive device; said switch to render said light responsive device inoperative when said film is in motion, and operative when said film is at rest.

▲

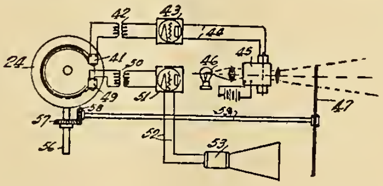
1,841,382. FILM STABILIZER FOR SOUND PICTURE PROJECTORS. JESS C. ROSE, Los Angeles, Calif. Filed Nov. 19, 1929. Serial No. 408,245. 1 Claim. (Cl. 179—100.3.)



In a sound projector having a film feed reel, sound record reproducing means, a slip-driven take-up reel, and film driving means for feeding the film to the reproducing means: a film sprocket mounted on the projector beyond the reproducing means and arranged to pull the film past said means, another film sprocket mounted on the projector over which the film subsequently passes before reaching the take-up reel, the film being formed with a loop between said sprockets, and the last sprocket acting as a hold-back against irregularities in film tension due to the operation of the take-up reel, and means to drive said sprockets together with the first mentioned film driving means.

▲

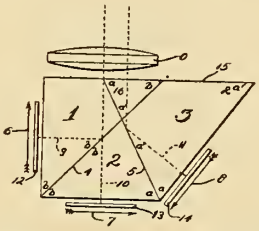
1,841,540. METHOD OF RECORDING ELECTRICAL IMPULSES FOR PRODUCING PICTURES AND SOUND. HARRY T. LEEMING, Jersey City, N. J. Filed May 31, 1928. Serial No. 281,959. 3 Claims. (Cl. 178—6.)



3. A system for recording and reproducing picture effects comprising a disc shaped record having inscribed thereon grooves with undulations corresponding to the picture effects, a drive shaft for rotating said record, a reproducing stylus and a magnetic pick-up head engaging said grooves, a reproducing circuit connected with said reproducing head, an amplifier in said circuit, a light valve controlled by said reproducing circuit and controlling a source of light, a scanning disc controlling said source of light gear connected with said drive shaft and means for projecting the light from said source, upon a screen.

▲

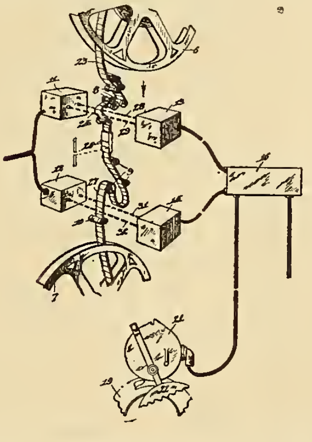
1,843,007. PLURAL IMAGE OPTICAL SYSTEM. LEONARD T. TROLAND, Cambridge, Mass., assignor to Technicolor Motion Picture Corporation, Boston, Mass., a Corporation of Maine. Filed Apr. 2, 1929. Serial No. 351,885. 8 Claims. (Cl. 88—1.)



1. Photographic apparatus of the type having a plural image forming optical train employing a common objective for the respective images, comprising a pair of partial reflectors disposed in planes making different angles with the axis of the objective and positioned to intercept different proportions of light from the objective.

▲

1,842,658. OPERATING MECHANISM FOR FIRE PREVENTION APPARATUS. JOSEPH ELLIS COHEN and JOHN FRANCIS ADAMS, Philadelphia, Pa., assignors to Sentry Safety Control Corporation, Philadelphia, Pa., a Corporation of Delaware. Filed June 1, 1928. Serial No. 282,245. 8 Claims. (Cl. 88—17.)



4. In combination with fire prevention apparatus for a motion picture machine which has a light source for projecting the images of a film and means for feeding the film, of a pencil of light adjacent the normal loop of the film, a control circuit for the apparatus including a photo-electric cell upon which said pencil is adapted to act and which, when the film loop is displaced abnormally and so as to interrupt said pencil will operate said apparatus.

Simple
Accurate
Essential

35 M. M. FILM SCALE

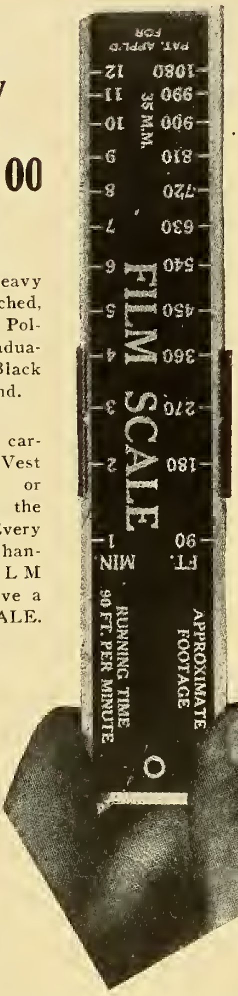
. . . Belongs in your TOOL KIT

Only

$1.00

Made of heavy Brass, Etched, Highly Polished Graduations on Black Background.

May be carried in a Vest Pocket or hung in the Booth. Every one who handles FILM should have a FILM SCALE.



GAUGE your own running time. FILM SCALE will tell you with the utmost ACCURACY the exact length of the film on the reel—it will tell you with perfect precision the length of time necessary to run that reel through the projector. No more guesswork.

Every PROJECTIONIST should own one and save a load of guesswork and trouble.

Fill in COUPON—pin a dollar to it

UTILITY SALES CO.
7 West 44th Street, New York City, N. Y.

Enclosed find $1.00 for one FILM SCALE and DIRECTIONS.

Name ....

Address ....

City .... State ....

THEATRE ....

Patents:

A department established for the solution of patent difficulties.

By RAY B. WHITMAN

Readers are urged to avail themselves of this free service for advice on the subjects of Patents, Trade Marks, Designs and Copyrights. If a personal answer is desired, a stamp should be enclosed with the inquiry; otherwise the question and its answer will appear in this department in the first available issue. Address all questions to the Patent Editor in care of THE MOTION PICTURE PROJECTIONIST. *Write on one side of the paper only, giving full name and address and business connection. (Only initials will be published if requested.)*

Q. What is a "basic patent"? Does this differ from an ordinary mechanical patent?

A. A basic patent is properly one which dominates an entire series of patents. For instance, the Selden patent, which was later declared invalid, might be called a basic patent on the ground that it covered every present-day automobile in claiming merely the combination of a road vehicle driven by a gasoline engine. All other automobile patents are necessarily subservient to it because requiring its use to make possible their use.

The term "basic patent," however, is often used improperly to mean a very broad patent and there are actually but very few true basic patents. An ordinary mechanical patent is the kind that the vast majority of patents are and may be directed to claim very broad and necessary combinations of elements not quite basic but still of possible great value in an art.

Time Required

Q. Is obtaining a patent a matter of months or years?

A. It is difficult to get a patent in much less than a year or two, since the various divisions of the Patent Office are from five to ten months behind in their work and each case must come up in its turn for examination. Usually at least two amendments are necessary, each requiring such an examination with its delay.

Thus the average time of getting through a simple patent at present is around two years, although the inventor is protected as to priority since his case is filed, and need not wait for the issue of the patent to exploit it. However, if the prospective patent right is being infringed, it is sometimes possible to have the application made "special" and get it set ahead of its turn for examination, in which case it would be possible to get the patent out in a few months, or certainly less time than a year.

Necessity for Model

Q. Must the application for patent be accompanied by a model of the device exactly as it will appear in the manufactured state, or will a fairly accurate working model suffice?

A. No model whatever need accompany the application, the use of models generally having been done away with years ago. Only in exceptional cases may the Examiner call for a model, as when the application is not clear as to its workability. The writer has filed over 1,000 patent applications and only in one or two stray instances were models submitted, and then they were only volunteered.

Q. Is it possible to patent a mechanical device merely from a complete set of drawings?

A. A complete set of drawings is amply sufficient from which to patent a mechanical device; in fact rough sketches showing the general idea and accompanied by a description in the inventor's own words is all that is usually obtainable.

Infringement Search

Q. Is the "infringement search" a part of the routine of the Patent Office, or is this the responsibility of the person applying for a patent?

A. The patent office makes no infringement search but only patentability searches. The former are directed to determining whether the claims are infringed and the latter whether the patents as publications prove the subject matter of the invention to be old and therefore unpatentable to the applicant.

Hence an infringement search is always the responsibility of the person applying for a patent and should be made before active steps to market it are taken in order to be safe against possible litigation. Much of the needless and expensive patent suits now pending would have been eliminated if this precautionary step had first been taken.

Q. Does the statement "Patent Applied For" on a manufactured article afford some measure of protection?

A. Yes, although the statutory marking has to do only with the issued patent. However, "Patent Applied For" should always be put on articles made and sold under a pending application for its restraining effect on competition as well as for the advertising prestige which it gives the article.

Fundamentals of Sound

(*Continued from page* 11)

ceeding alternations. This is depicted graphically in Fig. 1 by making the areas of compression near the piston dark and the more distant areas of compression gradually lighter in shade. Thus, because of dissipation caused by the distance of travel, the noise finally becomes inaudible.

Frequency Defined

One complete movement of the piston backward and forward constitutes what is known as a cycle. As has been demonstrated previously, it produces or consists of one area of compression and one area of rarefaction. Referring to Fig. 2, a complete cycle is indicated by the portion of the wave contained within the two dotted lines. The complete wave shown in the figure consists of four and one-half such cycles. It represents, therefore, four and one-half cycles of sound. It will be observed that the amplitude decreases as the wave moves forward. The horizontal distance covered by each cycle, nevertheless, does not change.

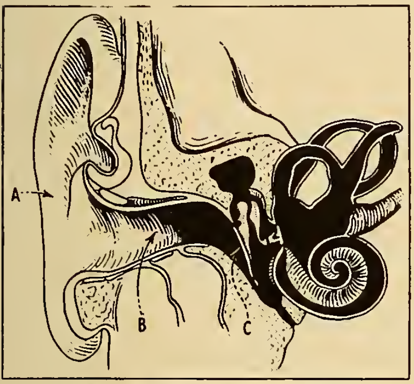


Fig. 4. Mechanism of the Ear

The frequency of the sound is defined as the number of cycles produced per second. For example: if the movement of the piston is such that it moves back and forth twenty times per second a twenty cycle wave is produced; if the movement is at the rate of ten thousand times a second, the result is a ten thousand cycle note. It may be seen, therefore, that a given rate of vibration per second results in a note of the same frequency as the number of these vibrations. The word "vibration" may be somewhat misleading, however, in connection with this explanation, in that a cycle is sometimes called a double vibration (abbreviated d.v.), because a cycle consists really of a compression and a rarefaction of the air, or a "double vibration." Frequency, however, refers to the number of complete cycles per second, and the word vibration is used in that sense.

Postponement Notice

Due to the fact that Mr. John L. Cass, author of the series of the articles on color photography appearing in this magazine under the general heading "Painting the Silver Sheet," was suddenly called out of town before having prepared his installment for this issue, our readers will have to forego the pleasure of his company until next month, when his fourth and final installment of the series will be published.

Wave Length Explained

The amplitude of the wave has absolutely nothing to do with its frequency, which is determined solely by the number of cycles per second. In fact two waves of the same frequency may have different amplitudes. This is illustrated in Fig. 3. The wave length of sound waves of the same frequency is identical. It is determined by dividing the distance through which the wave travels per second by its frequency.

Volume, on the other hand, applies to the amplitude of the sound wave and is not dependent upon the frequency. For example, there is more energy and therefore more loudness in the sine wave indicated by the dotted line in Fig. 3 than in the sine wave represented by the solid line, although the frequency (and therefore the wave length) of each is identical. Why the amplitude of the wave determines its loudness will now be explained.

The Human Ear

In Fig. 4 there is depicted a cross section of the mechanism of the human ear. The external part of the ear is known as the "pinna." It is designated in the drawing by the letter A. This, together with the "canal" (B), or tube-like arrangement leading into the head, forms what may be described as a trumpet which serves to gather and to conduct the sound waves to the "tympanic membrane" or eardrum (C). The eardrum is very sensitive to any movement of air. As far as our discussion is concerned, it is unnecessary to go beyond this point, although it may be observed that any movement of the eardrum causes impulses or sensations which are carried by the auditory nerves to the brain, where they are interpreted as sound.

Now, it is obvious that if the movement of the eardrum is quite appreciable, that is, if it vibrates with considerable amplitude, the sensations conveyed by the auditory nerves to the brain will be considerably stronger than if the movement of the eardrum were less. The brain, therefore, interprets it as the louder sound.

An analogy may be found in the sense of feeling. If we are touched lightly with a certain object, we barely feel it; but if the pressure exerted become greater, the feeling increases until it reaches such proportions that it becomes painful. This is likewise true of the eardrum. A sound wave of low intensity sets up in the eardrum a wave motion or movement of small amplitude. As the intensity of the sound increases, the amplitude of the vibrating eardrum increases until a point is finally attained at which the sensation is no longer interpreted by the brain as sound, but as feeling and it becomes painful.

VALLEN

Dares To Guarantee

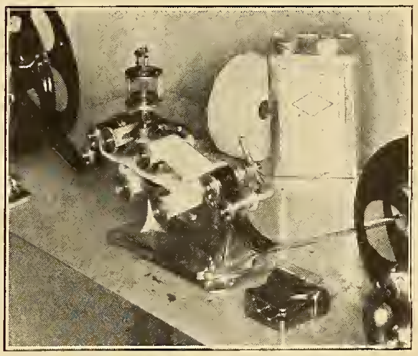
Proscenium equipment that is properly designed, carefully constructed and proved in performance justifies a bond of faith characterized as a guarantee.

Vallen Dares to Guarantee every product bearing the Vallen name.

VALLEN ELECTRICAL CO., INC.
Akron Ohio

Manufacturers of Noiseless All-Steel Safety Track, Noiseless Curved Track, Aero-Speed Control, High Speed Curtain Control, Junior Curtain Control, Automatic Screen Modifier, Adjustable Volume Ventilating Fan, Electrical Awning Operator.

Clean Films



Clean films mean good sound and picture. Our WIPER-CLEANER together with our FILMEX CLEANING FLUID removes oil and surface dirt which is so detrimental to good sound and picture projection.

Write for our interesting booklet

Film Processing Machinery Corporation
354 West 44th Street
New York City, New York

The brain is, of course, able not only to differentiate between the various degrees of intensity or loudness of a sound transmitted to it by the nerves of the ear, but it also has the faculty of distinguishing sounds of various frequencies, and is able to classify them as being tones of various pitches. In other words, it has the power of classifying a tone as being of a higher pitch if its frequency is higher, or of a lower pitch if its frequency is lower. In musicians this faculty is often very highly developed and they are able to determine the position of a sound in the tonal scale merely by listening to it.

Auditory sensitiveness to certain frequencies varies in different individuals so that sounds which are perfectly audible to some people cannot be heard by others. The range of audibility for a person of exceptionally good hearing lies between about twenty cycles as the lower limit and twenty thousand cycles as the upper limit. Many persons cannot hear sounds having a frequency above ten thousand cycles or even less. It is apparent that the ability to hear well is dependent to a large extent on the elasticity of the eardrum, because it is thus more sensitive to the movement of the sound wave or air within the ear.

(To be continued)

Dr. Goldsmith Praises Committee

The work of the Projection Practice Committee of the Society of Motion Picture Engineers, when completed, will be a valuable contribution to the motion picture industry, according to Dr. A. N. Goldsmith, president of the Society, who attended the last meeting of the committee.

"When I recall that the driver of a five hundred dollar automobile has at his command an oil gauge, a speedometer, an ammeter, a radiator thermometer, and what not, with which to 'Feel the pulse and take the temperature' of the machine continuously while operating it, I look with astonishment and sympathy at the projectionist, who is obliged to project pictures night after night before a one thousand dollar box office house, in a two-hundred thousand dollar theatre, literally, as it were, in the dark, and partially ignorant of the condition of the projector until its condition becomes so bad that the effect is seen upon the screen and is heard in the sound," said Dr. Goldsmith at the meeting.

"Then it is too late—the audience has seen the effect; consciously or unconsciously, the audience carries away a feeling of dissatisfaction, the magnitude of which depends upon the seriousness of the circumstance, and may look elsewhere for better pictures and better sound.

"When the Projection Practice Committee will have completed its work of determining all the tolerances, clearances, and tensions for all moving parts of the projector, as it has set out to do, and of determining the amount of wear to which these parts may be subjected with safety, it will have completed an invaluable piece of work.

"But the final economic results of the work will have been achieved when the Committee successfully indicates the simple means to be used by the projectionist to check these things, and the design of a cheap and simple kit of tools which he may use to do so. The Society of Motion Picture Engineers should do its best to make it easy for the projectionist to determine the exact condition of the projectors and to prove the occasional and timely need for replacement parts to the properly economical exhibitor. This means money in the exhibitor's pocket through better audience reaction, and also a more satisfactory and dignified position for the projectionist.

"Flicker, shaking of the picture on the screen, out-of-focus effects, poor sound reproduction, all of which can be caused by the wearing or the maladjustment of parts, will then be under the control of the projectionist, who will be able to check and to readjust or replace the faulty parts before they are allowed to annoy the audience, irritate the theatre owner, and drive away the patrons.

"For it is axiomatic that every business, to be successful, must serve the interests of the customer—the object of the motion picture theatre is to sell entertainment to its patrons, and everything that can be done to improve this product (the entertainment) will serve not only to maintain this patronage, but to increase it."

In addition to the study which forms the subject of Dr. Goldsmith's remarks, the Committee is working on such problems as the determination of screen brightness in relation to its effect upon the audience, and the advisability of stopping down the projector lens when projecting cartoons and other bright subjects, or otherwise getting the same effect; and the design of suitable apparatus for equalizing the sound outputs of the two projectors, so that no difference in sound level will be discernible by the audience when the change-over occurs.

The successful progress of the work of the Committee is due largely to the efforts of Messrs, Harry Rubin, Jesse Hopkins, H. Griffin. F. H. Richardson, P. A. McGuire, J. O. Baker, S. Glauber and George Edwards.

STILL PREFERRED

Above All Others

MORE Miehling books have been sold to projectionists than any other . . . . There have been others since Miehling's book was brought out . . . . and some at a lower price . . . . but Miehling's still remains as the *only book written by a projectionist for projectionists* . . . . That it why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of *all* sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.
519 pages . . . completely indexed

THIRTY-ONE chapters, each covering a phase of sound equipment operation, are thoroughly indexed in the back of the book, affording the projectionist full means of reference in case of trouble. The whole set-up of the book has been designed for leisurely reading or for quick use in a breakdown emergency.

ONE hundred and thirty-seven illustrations: diagrams, schematic drawings and photographs are scattered through the book, adjacent to connecting text. Continuity of text and picture is thus preserved throughout. A perfect book for projectionists.

Price $4.00, We Pay Postage

Mancall Publishing Corp.,
7 W. 44th Street, New York City
Send me Miehling's Sound Projection.
Enclosed find remittance of $4.00.

Name ....
Address ....
City and State..................................
Position ....
Theatre ....

Slit Losses in Sound Optical Systems

(*Continued from page* 21)

mum change or variation in light which only a very fine slit would experience when the above recording passed by. Let us call this difference in areas, Area III (Area I—Area II). In the above case (where the light slit has the width AC), if the film moves so that the slit occupies the position A′ C′, we might think that the quantity of light passing through to the photo-cell was different from that when the slit occupied position AC.

Such, however, is not the case. It can be shown mathematically, that for the above sine wave, the area under A′C′ is exactly the same as that under AC, so that the amount of light slit blocked out in this position is the same as before. Hence there is no variation in light when the slit has the combined width of a peak and valley, and consequently no sound is obtained for that frequency from the loudspeaker. This frequency is known as the *cut-off frequency*.

Losses—Cut-off Frequencies

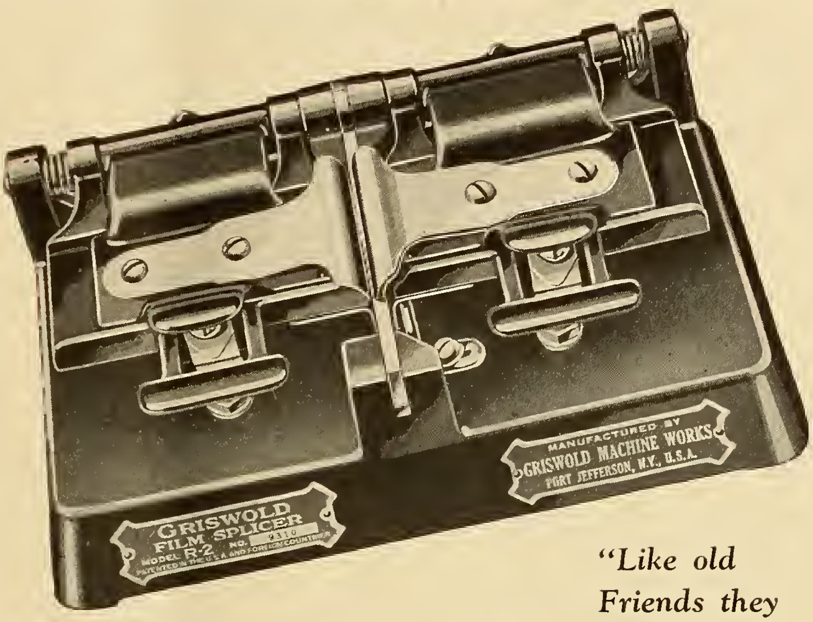
From the above it is evident that the finer the light slit, the narrower must be the peaks and valleys for one peak and one valley to fit into the slit. In other words, the cut-off frequency is higher for a fine slit than for a wide one, and hence the frequency response from the film is greater for a fine slit.

The above cut-off frequency represents the value at which no flicker of or variation in the light is produced, i.e., zero response is obtained. However, at a lower frequency, the peaks and valleys will be broader, so that one of each cannot be fitted together into the space of the given light slit. In this case, some variation in light will occur as the peaks and valleys pass by. As the frequency is lowered, the peaks and valleys broaden out more and more, and the response increases (light variation increases). The maximum variation in light will occur, at very low frequencies, and corresponds to the Area III mentioned above, which represents the maximum difference in blocking-out effect between a peak and a valley.

Hence, due to the fact that the light slit has a certain, finite width, the signal response from the film decreases as the frequency increases (slowly at first, but more rapidly as the frequency becomes higher), until, at a certain high frequency, the response is zero.

An interesting fact is that a response may again be obtained above the cut-off frequency. This is due to the fact that one peak, one valley, and a portion of the next peak, can all fit into the width of the light slit. This is an unsymmetrical condition, and hence a variation in light will be produced under these circumstances as the recording passes by the slit. However, when the frequency becomes so high that two peaks and two valleys can all fit into the width of the light slit, a second cut-off point is obtained.

This second cut-off point is of little practical interest. For, if we consider the normal width of light slit, namely, 0.001″, the first cut-off frequency occurs at 18″÷0.001″=18,000 cycles per second. This note is about at the limit of the audio range. The value in using a 1 mil slit (0.001″ wide) is not that we can theoretically



"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS
Port Jefferson, Long Island New York

• 13.6 mm x 22 inch •

One more double reel per trim

3 less carbons per twelve hour day

These results are reported by projectionists using the new 13.6 mm x 22 inch National High Intensity Projector Carbons.

No increase in price

Improved manufacturing facilities permit this new length to be offered at the same price as the 13.6 mm x 20 inch carbons formerly supplied.

NATIONAL
PROJECTOR CARBONS

NATIONAL CARBON COMPANY, INC., Cleveland, Ohio
CARBON SALES DIVISION
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York, Pittsburgh, Chicago, San Francisco

HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.

SOUND REELS

For Perfect Projection

ALL-WELDED TYPE
One Unit

LASTING DURABILITY
Bright Cadmium Plated

—All Sizes—

DEMOUNTABLE TYPE
Each side one unit

ALL PARTS REPLACEABLE
Write for quotations

UNIVERSAL ELECTRIC WELDING COMPANY
9-16 Thirty-seventh Ave., Long Island City, N. Y.

KEEP all your COPIES of *MOTION PICTURE PROJECTIONIST* AS A REFERENCE FOR CURRENT AND FUTURE NEEDS—PRESERVE THEM IN A BINDER

BINDERS

$2.00 each

GOOD SOLID IMITATION LEATHER —GET ONE

ORDER FROM THE MOTION PICTURE PROJECTIONIST

record and reproduce such a high frequency as 18,000 cycles, but rather that at frequencies of 5,000 and 6,000 cycles, the attenuation in light variation is not very serious, and a satisfactory response up to these frequencies can be obtained.

Compensation for Losses

The attenuation that does occur at the higher frequencies can be compensated for by tuning the recording oscillograph, or "peaking" its amplifier response, so that it is more sensitive at the higher frequencies. These are usually very weak as encountered in practically all sounds, so that there is little danger that these will overshoot the sound track when overemphasized. In this way it is possible to compensate not only for slit losses in recording, but in reproducing as well.

The above exposition carries with it a moral to the projectionist. If you want the best sound obtainable from your apparatus, see that the light slit conforms with the requirements mentioned above. Practically, this means a clean sound gate, clean optical system, and perfectly focussed exciter lamp, in order that the focal, rotational, and lateral adjustments to the optical system (as made by the factory or service engineer), can produce as fine an optical slit as possible on the sound track, and one that covers the track, and is perfectly square with it. The importance of these requirements cannot be overestimated.

Vertical Sound Records

(*Continued from page* 16)

there is anyone in this room who would not enjoy the sound of a contralto singing "Silver Threads among the Gold" or something of that kind. The sounds are pleasing to everyone. The high frequencies—the soprano, the locomotive whistle—are annoying to the nerves, not to the ear.

MR. SHEA: I think there is a great deal in what Mr. Richardson has said. It is probably true that most sounds which are startling or grating, as some people call them, have a large high frequency content. It seems to be the general experience that for the high frequencies you must have clearer reproduction.

MR. KELLOGG: Quite a little comment seems to have been inspired by the idea that during some of the numbers there was a kind of unnaturalness, particularly where there was fairly complex music—for example, the orchestra. It sounded to me as though it might possibly have been due to some imperfection in the correspondence between input and output—non-linear distortion as we sometimes call it, or it might have been an effect such as one gets when in a room with an orchestra and the reverberation is rather high, particularly in the high frequency range. I should be interested to know in the case of the orchestra recording whether the acoustics of the recording room were such as I have described.

I have another question: The piano was very steady and firm, a condition which obtains only when the turntable is rotating very steadily. A year and a half ago a turntable mechanism was described wherein a great deal of refinement was gone into, to avoid speed irregularities. I should be interested to know whether that type of turntable is used both in recording and reproduction in this case.

MR. FREDERICK: In answer to the first question, as to whether there was not some nonlinear distortion somewhere in the system, I do not think there is any question but that there is, but I believe that there was perhaps less of it than we sometimes hear.

The conditions of the pick-up of the sound were not what we should have chosen if we had had a place where we could move the microphone about. A single microphone had to be placed close to the conductor; those conductors to whom I have spoken, and in whose opinions I have great confidence, insist that they cannot judge from the conductor's position what the orchestra should sound like. They have to permit another conductor to rehearse the orchestra, so that they may go out into the body of the hall to get the correct effect. As to turntable speed control, the recording machine was the usual Western Electric Company recording machine. The reproducing turntable was driven by a synchronous motor with multiple belt speed reduction.

Filter Characteristics

Mr. Maurer: How abrupt was the cut-off of the low pass filter used in this demonstration?

Mr. Frederick: The cut-off is quite abrupt. A matter of a few hundred cycles means a great many "db.'s."

Mr. Thompson: Is this type of reproducer more responsive to vibrations of the turntable, or irregularities of that kind, than is the present lateral pick-up?

Mr. Frederick: Of course these records would not play on a seventy-eight rpm. turntable, because they were recorded at thirty-three rpm. They are far less sensitive to certain types of irregularity, due to the small mass of the pick-up and the small pressure on the record. We had a record one time that was pressed with a stamper, that had been bent at least an eighth of an inch out of plane, out on one edge, so that there was a big bulge in the record. The reproducer tracked over this without difficulty, and no trouble was experienced in the reproduction in doing so—until the pick-up reached the point where the frame of the reproducer hit the bulge in the record.

As to vibration, I should hesitate to say, because it would seem off-hand that a vertical reproducer would tend to be somewhat sensitive to it. So far as my experience has shown, it has seemed to be certainly no more sensitive to that type of trouble, and my impression is that perhaps it is a bit less sensitive. But I should hesitate to make a definite answer on that.

Range of Radio Receivers

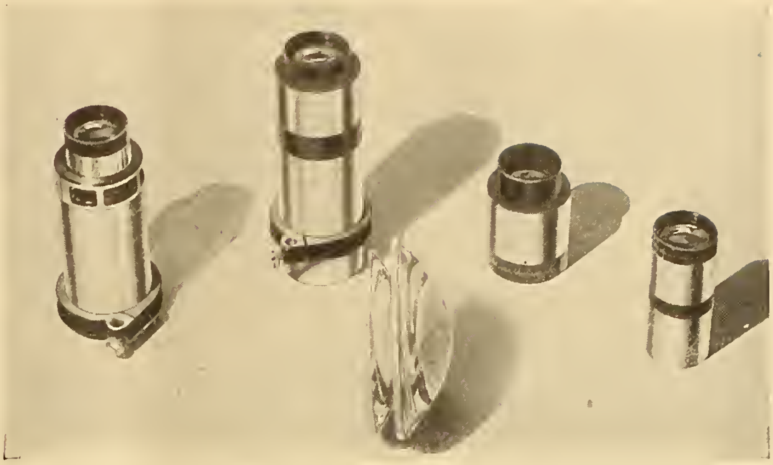
Mr. Olney: The question of the frequency range of radio receivers has been raised in the discussion several times, and someone inquired as to how it compared with the reproduction we heard today. There is no comparison between them. In order to reproduce the low frequencies you have been hearing today, a receiver cabinet would have to be the size of the panel you see there, which is out of the question.

As far as high frequencies are concerned, the requirements of selectivity prohibit reproduction of anything higher than five thousand cycles. This is a theoretical limit. Practically, the response drops off in the best radio receivers between four and five thousand cycles. In the poorer receivers it may drop off at three thousand cycles. In radio receivers equipped with the so-called tone controls, it may be possible for the user to reduce the cut-off frequency to fifteen hundred cycles. Some persons prefer that.

I do not think it is because they object to a normal amount of high frequencies. Some have claimed that what annoyed them were the frequencies above five thousand cycles. Those frequencies, I believe, are not reproduced by any radio receiving set on the open market today with which adjacent stations can be separated. I believe that one of the difficulties is that most loud speakers used in radio receivers have a very exaggerated response to frequencies in the neighborhood of twenty-five hundred or three thousand cycles; and unless these peaks are suppressed in some manner, the reproduction is bound to be unpleasant.

In commercial receivers, correctly designed, an attempt is made to equalize these defects in the loud speakers. When they are not equalized you will get this impression of harshness in the upper register; but this is not due to the frequencies above five thousand.

Mr. Victor: I am afraid these discussions will read as if our Society members criticized



SUPER CINEPHOR

for Higher Screen Brilliance

Crisper Definition, Sharper, Complete Coverage

Super Cinephor increases the entertainment value of every production . . . improves the show from any seat in the house with superior definition, higher screen brilliance and full, sharp coverage.

Ground in focal lengths down to 2 inches the Super Cinephor gives unexcelled picture quality to the outmost edge of either standard or wide screens.

Use Super Cinephor with the new B & L Condensing System . . . get 50% to 100% *more* light projected to the screen.

Write today for descriptive literature on this remarkable projection lens . . . then get full details from the nearest office of the National Theatre Supply Co.

Bausch & Lomb
Optical Co.
680 St. Paul Street
Rochester N. Y.

BAUSCH & LOMB

·PHOTO-ELECTRIC CELLS···

(CAESIUM ARGON TYPE)

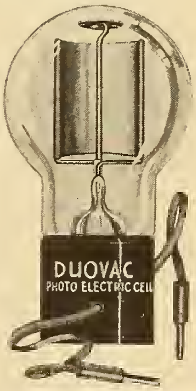
Write for descriptive folder illustrating the new 242, Power Amp. 264A, designed to replace the 239A, and the 205D. Also other tubes for all sound systems.

Guaranteed longer life, unaffected by heat through continuous usage and offers a new degree of tone fidelity—the result of Duovac painstaking research. Guaranteed, non-microphonic.

Complete tube equipment now available for the following sound systems: WESTERN ELECTRIC, R. C. A. PHOTOPHONE, De FOREST PHONOFILM, PACENT, and every other standard make.

· DUOVAC ·
RADIO TUBE CORPORATION
360 FURMAN STREET
BROOKLYN, N. Y.

Guaranteed! BETTER SOUND—*Lesser Cost*



Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

Rheostat leadership may be claimed by many, but we have it—

"Perfection" in name and performance.

Motion picture theatre owners and projectionists from Maine to California endorse our claim and know it's no idle boast.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Specialists

RHEOSTATS

INSURE YOUR JOB!
Study F. H. Richardson's
Handbook of Projection

Three volumes containing over 1,400 pages of vital knowledge with question and answer index. Every projectionist needs this authoritative guide. See your local theatre dealer or send for full details.

CHALMERS PUB. CO.
516 Fifth Ave., N. Y.

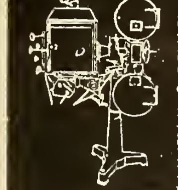
THEATRE EQUIPMENT
NEW AND USED

Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.

Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.

We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.

Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO., 844 So. Wabash, Chicago



Give This to Your Friend—Have Him Fill It in and Mail to us at Once

The Motion Picture Projectionist
7 West 44th Street, New York City

Gentlemen:

Enclosed please find $2.00 for which enter my subscription for one year (12 issues) starting with............................issue. (Two years, $3.00.)
Add 50 cents for Canadian postage; $1.00 for foreign.

Name ....

Street ....State ....

City ....Local No. ....

this performance. I should not like to see the records so appear after such a splendid performance. It is the best I have ever heard.

President Crabtree: Exactly. But we must not close our eyes to the imperfections. We will never progress if we do not criticize our own work. The man who is satisfied with his own work never gets anywhere.

Mr. Frederick: I should like to add a comment suggested by something Mr. Victor said, that I may not have properly answered. As the volume level of any reproduced sound is raised or lowered, the quality appears to change, due to the physiological characteristics of our hearing. If it is played too loud the balance is off in one direction, and if it is played softer than in the first place the reproduction is off in another direction, even though the frequency characteristics of the reproducing system, taken either in part or in whole, are entirely flat.

Now, one interpretation of his comment might be that if a person simply must play the reproduced sounds too loudly, he needs to have a certain amount of distortion to make up more or less for what his ear is doing. Of course, I do not think that is the proper thing to do. He ought to endeavor to play the reproduced sounds at the level at which they were originally produced and picked up. If that were done he would not need that kind of a compensating system.

Mr. Hickman: Mr. Victor put a point for me, that I had in mind. I think that anybody in reading this discussion might imagine that our criticism had been of this demonstration. This demonstration has been the most perfect music I have heard. My own criticism referred to reproduced music in general.

No Comparison to Radio

Dr. Goldsmith: There were two points about this extremely interesting and significant demonstration, which I believe merit consideration: In the first place, comparisons were made to radio. There is no possibility of comparison to radio, because transmitting stations today send out approximately forty-five hundred cycles. The networks of the country carry very little above that. A few stations are going up to approximately eight thousand cycles in transmission. But taking five thousand cycles as the present transmission of radio stations, it is obvious that a wide open receiver, receiving from zero to ten thousand cycles, would get only the upper five thousand cycles of extra noises superimposed on the signal; and a five thousand cycle low pass one would be perfectly justifiable.

If, below that, there are cut out frequencies from five thousand down to three thousand, then reception suffers considerably. A great many people prefer that, however, because they have been working in noisy locations all day, and want to be soothed rather than given an esthetically true reproduction.

Then, a corollary of that is that home conditions are not the same as conditions in an auditorium. If you listen to a great conductor, you discover that the faintest whisper of sound can barely be heard, whereas, the climax following immediately, nearly brings the plaster off the ceiling, if the theater has not been acoustically treated. That condition must not exist in the home for the reason that a radio receiver in the home would be an intolerable nuisance and would start a neighborhood feud. We have to limit the volume range. We have something here that is adequate, indeed, for home purposes, and has the maximum of volume range which is permissible and consistent where people live near each other.

Standards and Reactions

Another feature that we have to take into account is our own reaction when we hear things for the first time, in that we have a habit of reverting to old standards. I remember the first time a certain man, who was quite a capable man in his field, listened to a modern record, and remarked, "That is not good at all. It does not sound like a phonograph." And so we have to be careful. We must remember that we have all made a mental adjustment, a charitable adjustment if you wish, to reproduced music. We have accustomed ourselves to making mental allowances, applying the necessary automatic corrections. And we apply them to something where they are no longer relative.

I regard this as a most impressive demonstration. And throwing a bright light on nature, and holding up a brightly polished mirror to look at nature, is crude, but it is the only way to progress.

One other point, and that is the matter of the capabilities of film records. It is to be hoped and believed that results like this will properly stimulate the production of film records for theater use, which will be of equivalent quality. There is nothing theoretical or impossible about that. The trouble now is not with what is on the film, but the acoustic qualities of the theater.

MR. FREDERICK: I think it would be hopeless to try to summarize all the discussion which has taken place.

I regret that I am not fully familiar with all the facts regarding the transmission circuits of the networks connecting studios to radio stations. I know a great many of them are good to eight thousand cycles, and a great deal of effort has been made to make them good to eight thousand cycles. I think it would be unfortunate and quite incorrect if we should take away with us the impression that the transmission circuits were limiting or will limit radio transmission to five thousand cycles.

Aperture Standards Adopted by Major Producers

The major motion picture studios and theatre circuits have adopted a uniform practice governing the image area on 35 mm. film for photography and projection which will result in an important improvement in photographic quality, the Academy of Motion Picture Arts and Sciences announced recently.

This completes one of the final equipment changes in the transition from silent to sound pictures.

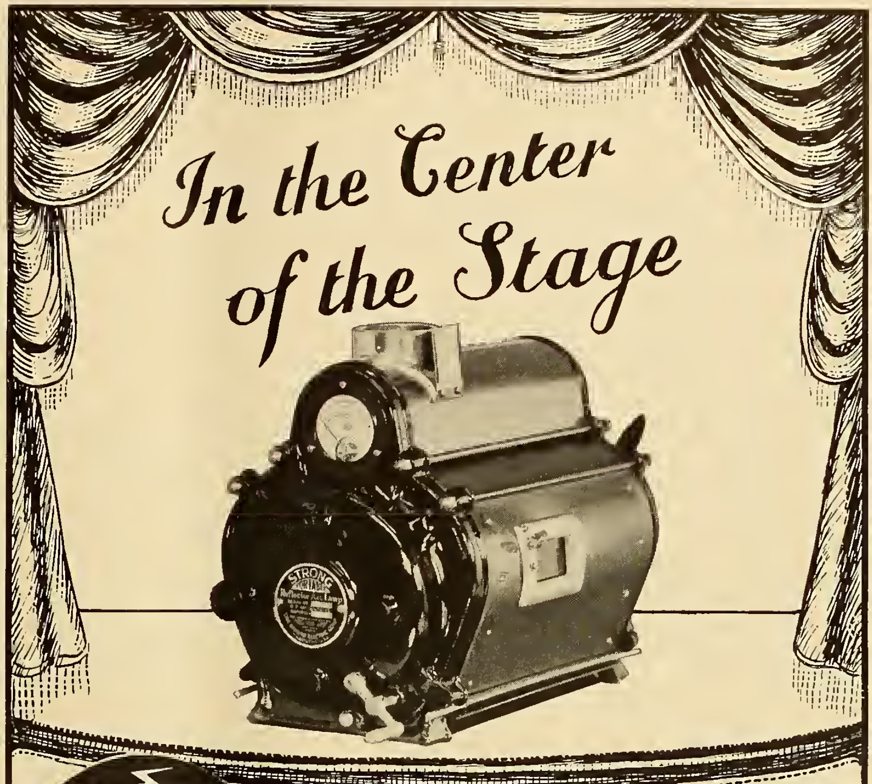
Companies which are putting the Academy specifications into effect for forthcoming productions include: Columbia, Educational-Metropolitan, Fox, Hal Roach, Metro-Goldwyn-Mayer, Paramount, RKO-Radio, United Artists, Universal, and Warner Brothers-First National.

Studio camera apertures will be immediately adjusted to photograph an image .868″ by .631″ on the negative, with center line .7445″ from the control edge, to be correlated to theatre projector apertures .600″ by .825″, with center line .7380″ from the control edge, the difference being necessary allowances for shrinkage and mechanical tolerances.

Specifications and instructions for adapting apertures, lenses, and screen masks will be distributed to the projectionists of all theatres in the United States during the next two months.

The uniform practice will apply to all types of motion pictures made for exhibition in theatres and will supplant the different image areas used for disc prints, sound track prints and silent versions. It is expected to settle difficulties which have vexed studios and theatres since the introduction of talking pictures and to end the wide variation in projector apertures for which studios have had to provide in photography.

Principal advantages of the uniform practice will be that when equipment is adjusted to the specifications, movable lens mounts, sliding aperture plates and other adaptive devices may be dispensed with in theatres, the likelihood of cutting off heads and


In the Center of the Stage
STRONG PORTABLE Reflector Arc Lamp

STRONG

Portable Type Reflector Arc Lamp

The sensation of the industry—this new lamp, designed for projection of 35 or 16 mm. film.

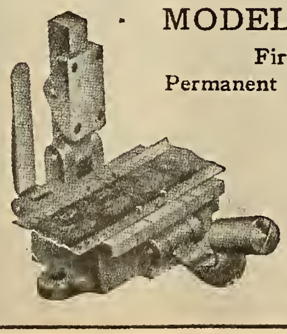
Gives a brilliant picture as large as 8 to 12 feet wide, even on porous screens, making it especially valuable with sound equipment.

Operates from any lamp socket with current from 8 to 16 amps. Weighs less than 25 lbs. Size 18″ x 12″ x 10″. Extremely simple in operation.

A new rectifier unit as companion to this lamp is also available.

For sale by Independent supply dealers

The Strong Electric Corporation
2501 Lagrange St., Toledo, Ohio
Export Offices: 44 Whitehall St., New York, N. Y.



Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

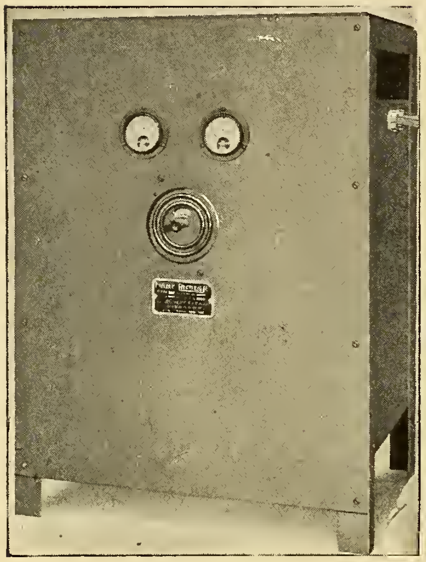
First-Class Results on New or Old Film
Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers

Good Projection Requires Good Rectification



M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes, then the other two, as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP.
New and Wilsey Sts.
Newark New Jersey

feet of characters on the screen will be reduced, and both studios and theatres will be assured that the full height of the photographed image will be transferred to the screen. Increased efficiency in photographic operations on the studio set will also be made possible through the matting out of wasted film area which it has been necessary to photograph to accommodate variation in theatre apertures.

Projection of the picture image by the new specifications will result in screen proportions of approximately three by four in theatres with medium projection angles. The screen will appear slightly wider when the picture is projected from a low angle and slightly taller in theatres with steep projection angles.

The present agreement among the companies to adopt a uniform practice has developed from research, surveys and conferences between representatives of studios and theatres during the past ten months, under the sponsorship of the Academy Producers-Technicians Committee. For the past two years studios have been composing sound pictures according to temporary recommendations issued by the Academy until theatre projection conditions should become sufficiently stabilized to warrant establishment of more permanent specifications.

NO MORE CELL WORRIES

TELEPHOTO
PHOTOELECTRIC CELLS

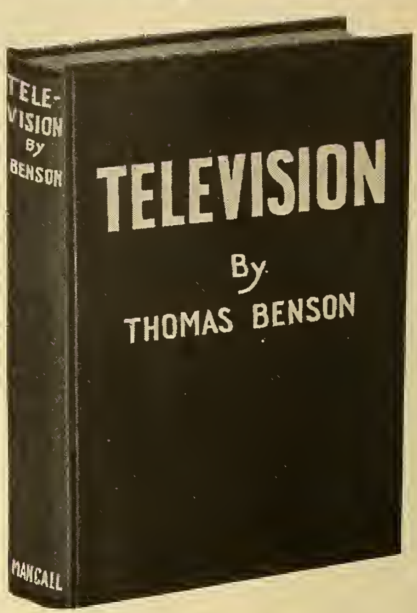
The accuracy and sensitivity achieved in the Caesium Argon cell assure the highest quality of tonal reproduction—lifelike and without distortion.

Guaranteed for 6 months, but should last longer.

Pamphlet and Prices on Request

TELEPHOTO & TELEVISION CORP.
133-135 West 19th Street
NEW YORK

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today. It is a book both for the interested layman and for the craftsman who will shortly depend on television operation for his livelihood. It has been written especially for the motion picture projectionist who will unquestionably operate television in the theatre as he now does sound equipment. The serious projectionist will get a copy at once.

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

TELEVISION
By Benson $2.00

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th Street, New York City
Enclosed find money order for $2.00.
Please send me Benson's Television.

Name ....
Address ....
City and State..............................
Theatre ....

Dr. National

—specialist in the treatment of

Projection Ailments . . .

Good projection and perfect reproduction of sound pictures constitute the Spinal Column of profitable theatre operation. Without them all the technique and finesse of perfect photography and sound recording are sacrificed . . . . and the sacrifice is usually traceable directly to projection equipment that is not in proper working order. Most frequently a small adjustment or the application of some needed accessory will correct a faulty condition. National Service is always at your call—day or night—for the prevention of trouble and the cure of dangerous projection ills.

Don't Wait for trouble— Prevent it with our FREE INSPECTION SERVICE . . .

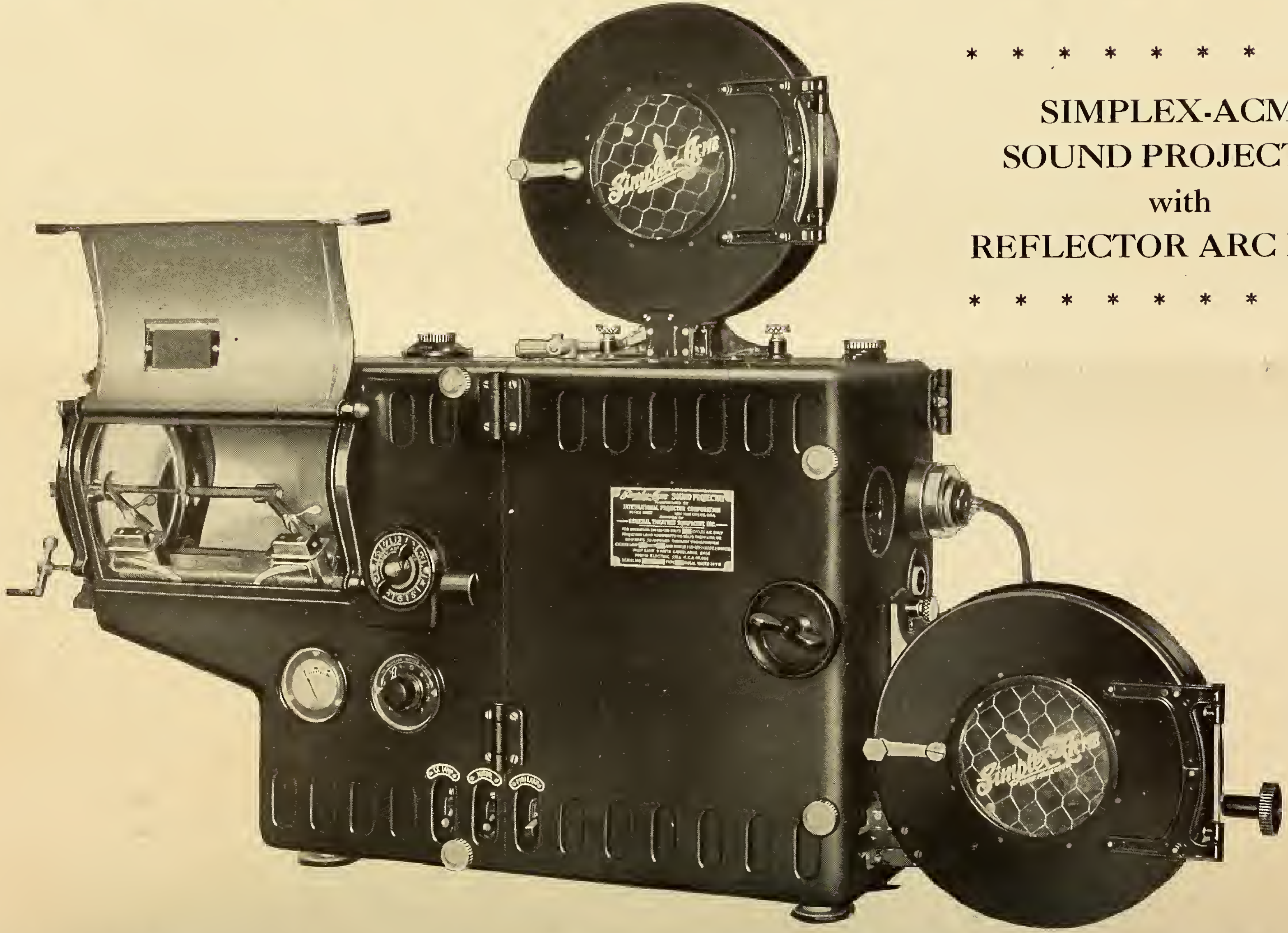
NATIONAL THEATRE SUPPLY COMPANY

YOUR LOGICAL SUPPLY SOURCE

SIMPLEX-ACME SOUND PROJECTOR

Provides Excellent Sound and Visual Projection for

LARGE AND SMALL AUDITORIUMS



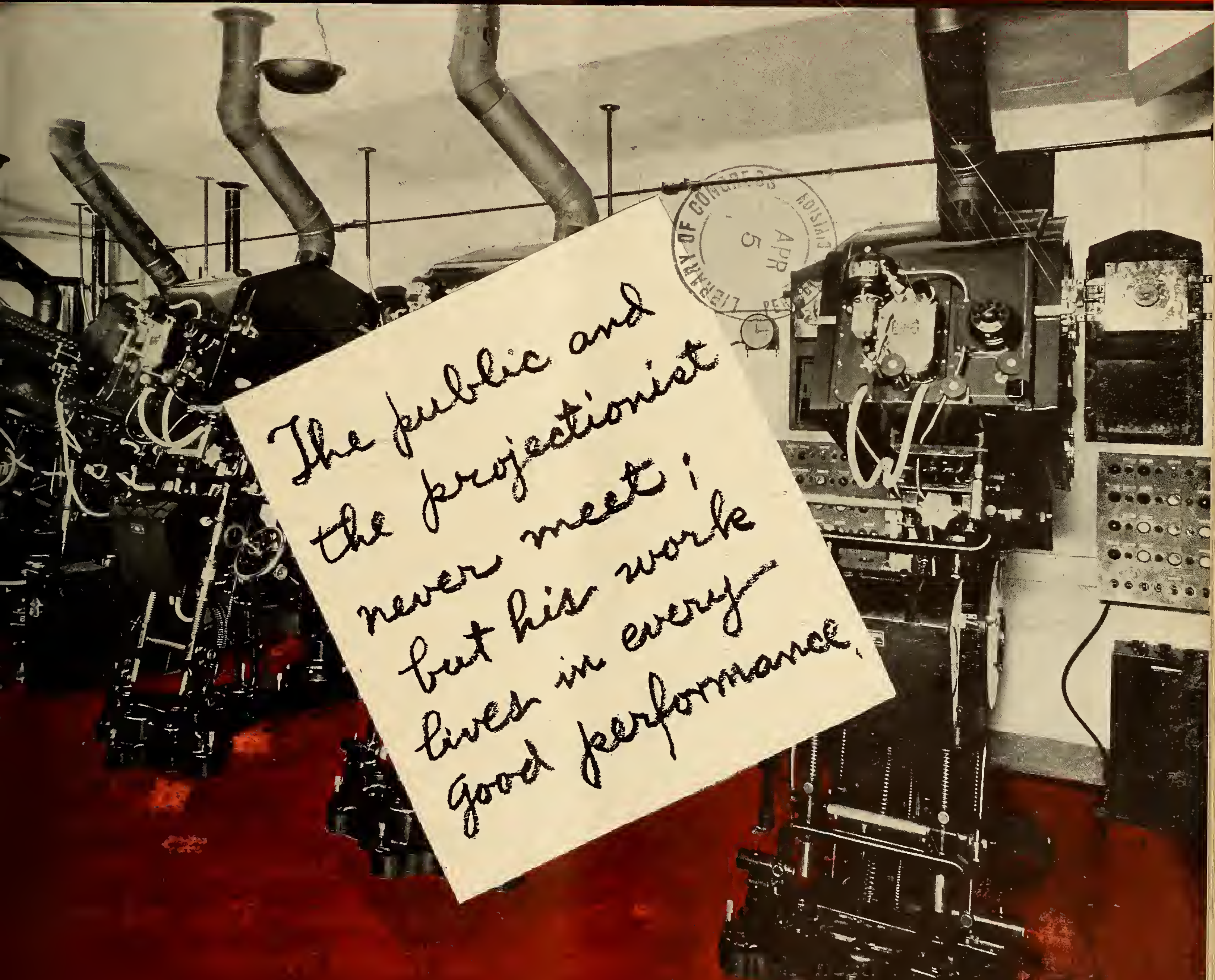
* * * * * * * * * *

SIMPLEX-ACME
SOUND PROJECTOR
with
REFLECTOR ARC LAMP

* * * * * * * * * *

INTERNATIONAL PROJECTOR CORPORATION 90 GOLD STREET
NEW YORK CITY

MOTION PICTURE PROJECTIONIST



LIBRARY OF CONGRESS
APR 5
PERIODICALS

Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.* Editorial and Advertising Offices, 7 West 44th Street, New York City. Entered at New York Post Office as second class matter, October 25, 1927

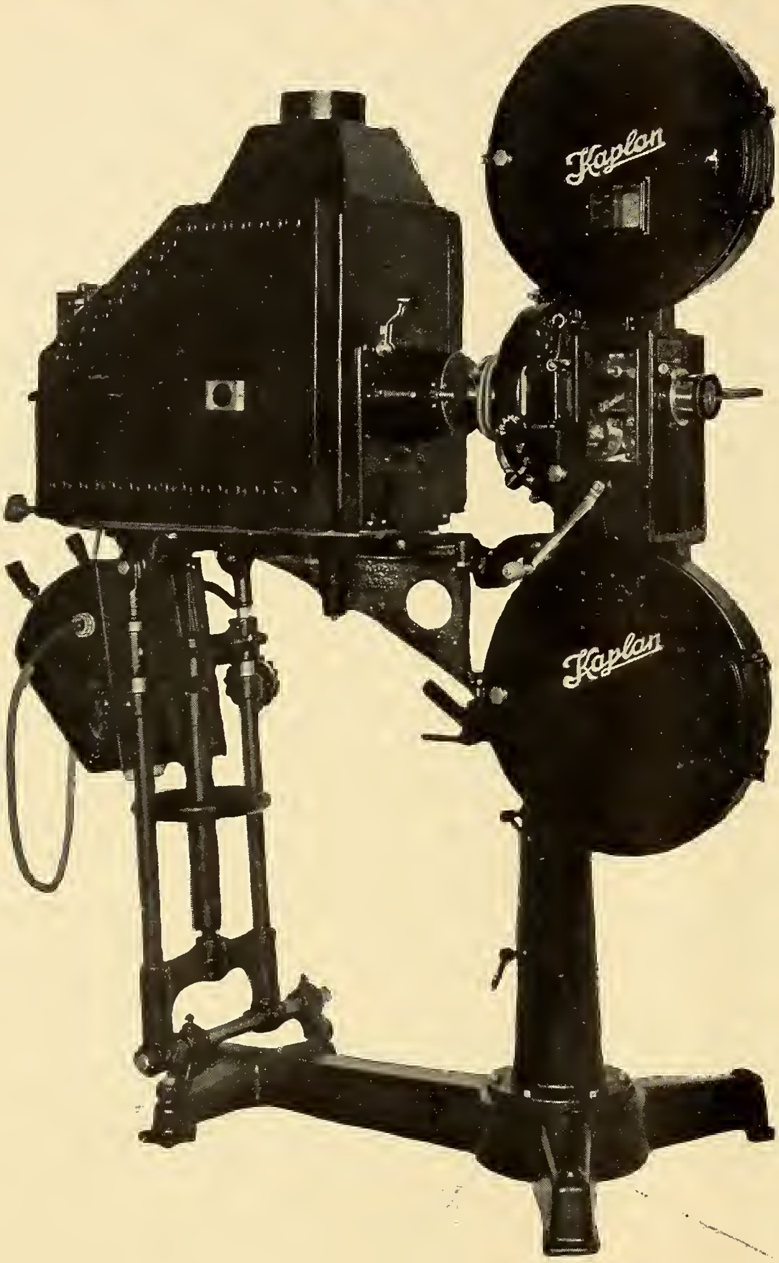
Vol. 5 • No. 6
25c per copy $2 per year

April, 1932

FIFTH YEAR OF PUBLICATION

Kaplan

PROJECTOR



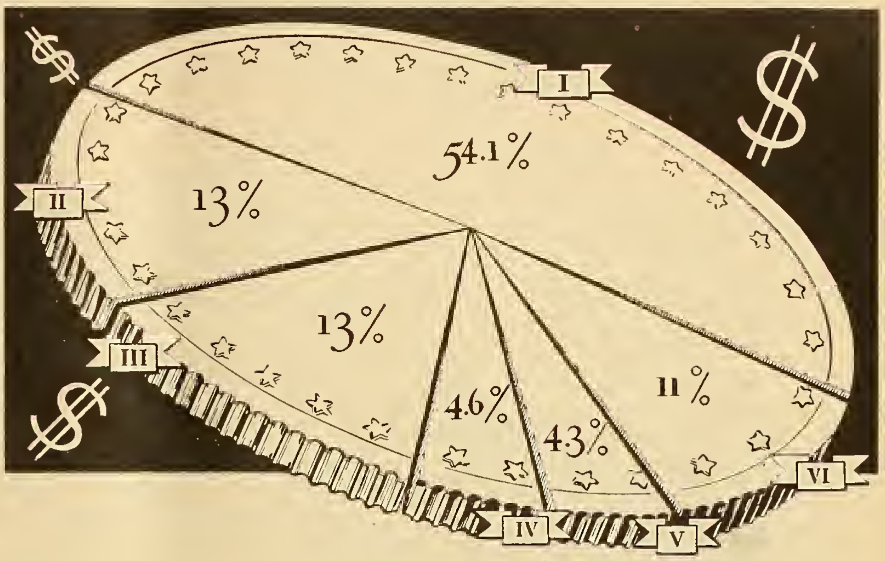
The Kaplan Projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

An Engineering Product

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue :: :: New York City

What your ERPI SERVICE dollar *buys* . . . . . .



These facts show how each ERPI Service dollar protects the exhibitor

I *54.1% for the inspection service* that prevents trouble—rendered by 600 men traveling 5,720,000 miles a year—to maintain highest standard of tonal quality.

II *13% for emergency and appointment calls* which would be greater except for the preventive inspection service.

III *13% for maintenance* of 35 branch offices, 173 other service points and $750,000 stock of spare parts which make possible immediate emergency repairs, quick replacements.

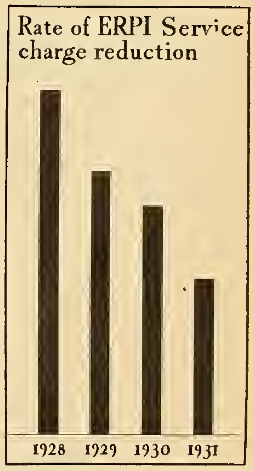
IV *4.6% for replacements,* repairs and improvements made at ERPI cost and for maintenance of Bureau which reduced repair costs 46% in 1931—saving exhibitors over $750,000!

V *4.3% for general administration* and engineering which make possible efficient nation-wide service and uniform quality operation.

VI *11% for protection against fire loss*—assuring complete replacement immediately without cost to exhibitor.

5 years of ERPI SERVICE experience made this economic dollar division possible

Experience with more than 8000 theatres proved to us that further reducing the number of preventive calls means *increased emergency and appointment calls!* ℂ To reduce branch points and stocks would endanger maintenance of service—which would prove costly to the exhibitor. ℂ ERPI's protection against fire loss by immediate replacement without loss of time is an economy of ERPI service. ℂ All economies made possible by five years of developing the present efficiency of ERPI Service have been reflected in repeated and voluntary adjustments of the service charge.



These ERPI economies have resulted in savings of more than $7,000,000 yearly to exhibitors—without impairing quality and performance.

Western Electric
THE VOICE OF ACTION
SOUND SYSTEM

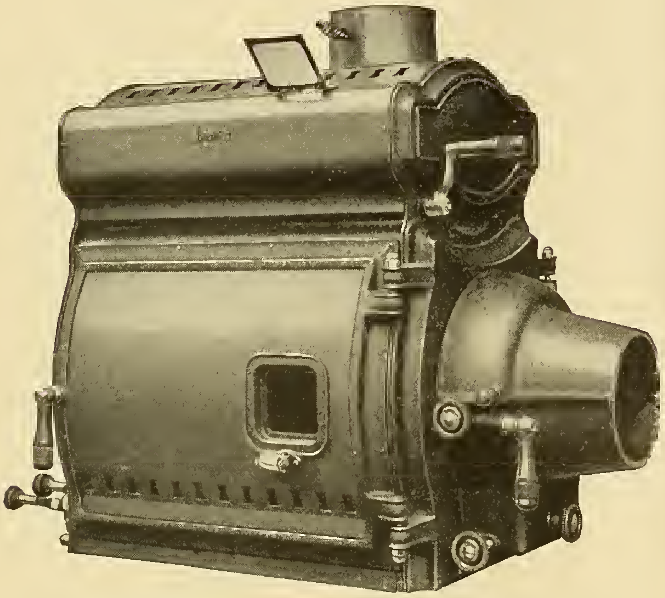
Northern Electric in Canada
Distributed by
Electrical Research Products Inc.
250 West 57th Street, New York

From Every Point of View

Brenkert

SUPER HIGH INTENSITY PROJECTION LAMPS

fulfill the strictest demands of motion picture projection.



More light . . . whiter light . . . more accurate operation . . . lower maintenance expense . . . backed by 20 years' experience in the manufacture of projection equipment.

IN USE FROM COAST TO COAST

Distributed by Progressive Independent Supply Dealers

Ask Any User

A Brenkert PRODUCT

Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.

Engineers & Manufacturers

ST. AUBIN AT EAST GRAND BLVD., DETROIT

S. M. P. E. Active in Projection Field

THE Society of Motion Picture Engineers, through the medium of its various committees and sub-committees, is maintaining its customary zeal in attacking the problems of projection. Interest is not confined to any one phase of the subject but embraces in some measure every vital problem of the day.

Recognizing, for example, the supreme importance of screen maintenance in its relation to good projection, the Projection Screens Committee, under the able leadership of Mr. S. K. Wolf, is devoting intensive study to the problem of refinishing and surface treatment.

The problem has been approached in a manner which is eminently logical in its application. A carefully planned investigation has already resulted in a clear definition of screen requirements and an appreciation of the inadequacy of present methods to meet these requirements. Some conception of the extent of the problem may be gained from a review of a few of the questions which have arisen during the course of the investigation.

In soliciting the opinion of committee members it has been found that there exists considerable variance on the question of painting or spraying screens while they are in an erect position in the theatre. It is the contention of some that such a practice results in an appreciable variation in reflecting power when the screen is subjected to white light. Variations of this nature, it may be observed, cannot be determined by the usual laboratory method of conducting experiments with small samples of screen material, for they occur from point to point on the screen.

Visibility of seams is another subject which is engaging the attention of the Screens Committee. It has been found that some screens now in use are actually unfit for the purpose because of the obviousness of seams, even when pictures are being projected. Another factor of prime importance is that there is a marked lack of uniformity in the manufactured product. It is claimed that tests have indicated that in some instances the findings with respect to one screen of a given manufacturer differ widely from another of the same type from the same source.

The loss of reflecting power caused by the accumulation of dust and dirt still constitutes a formidable problem and has attracted considerable attention for the past year. This and the deterioration of screen surface occurring with age bid fair to occupy a prominent place in the screen problem for some time to come.

In connection with this latter subject, a study is now being made of the effect of age upon the pigments and the vehicles used to carry the pigments with which these screens are coated. It has already been discovered that actinic light has a marked deleterious effect on the color value of certain paints, and it is proposed to enlist the services of pigment manufacturers themselves in an effort to solve the problem.

Like the Projection Screens Committee, the Sound Committee has been far from idle. An analysis of the various factors contributing to good sound in the theatre is now being made, and an outline is being prepared which assigns to each the importance it deserves. The result of this work will lie in the classification of various problems, the formulation of a constructive program, and the segregation of items which are amenable to standardization.

The first step in this program involves the listing of all possible sources of distortion which may be found in recording and reproducing systems and the creation of a bibliography on the subject.

Some progress has already been made in the study of elements for classification. The sub-committee, the function of which it is to study the variations that occur in making negative exposures, has already rendered its preliminary report.

MOTION PICTURE PROJECTIONIST

April, 1932 Vol. 5, No. 6

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Boone Mancall

Editorial & Advertising Office
7 West 44th St.
New York City.

273

A SIMPLE EXPEDIENT NOW BRINGS YOU BETTER PICTURES

A YEAR ago Eastman announced the first super-speed negative film—a medium that helped to set up new artistic standards in the motion picture industry. Now a simple expedient—a gray backing on the film base—gives you *even better* pictures. When you run a release that is truly exceptional in photographic quality, the chances are it was made on this perfected Eastman Supersensitive Negative. Eastman Kodak Co. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN *SUPER-SENSITIVE*
Panchromatic Negative (*Gray-backed*)

VALLEN proscenium equipment is designed to enable the projectionists to correlate its operation with the projection equipment, thus enhancing the artfulness and glamour of the presentation.

Detailed information on request.

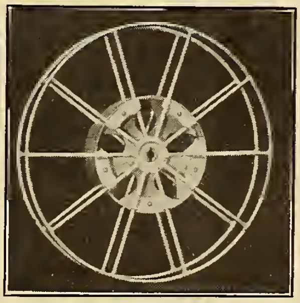
VALLEN ELECTRICAL CO., Inc.
AKRON, OHIO

VALLEN
PRODUCTS

Noiseless All-Steel Safety Track, Noiseless Curved Track, Aero-Speed Control, High Speed Curtain Control, Junior Curtain Control, Automatic Screen Modifier, Adjustable Volume Ventilating Fan, Electrical Awning Operator.

DARES TO GUARANTEE

SOUND REELS



Professional
16Mm. 7" 400 ft.,
35Mm. 10, 11, 14, 15"
for 1000 and 2000 feet.

All Welded
and
Demountable
Types
Cadmium Plated

Patented
WILL OUTLAST ANY OTHER REELS
UNIVERSAL ELECTRIC WELDING CO.
9-16 Thirty-Seventh Avenue Long Island City, N. Y.

Strong

SMALL IN SIZE
BIG IN POSSIBILITIES

The sensation of the industry—this new lamp designed for projection of 35 or 16 mm. film.

Gives a brilliant picture as large as 8 to 12 feet wide, even on porous screens, making it especially valuable with sound equipment.

Operates from any lamp socket with current from 8 to 16 amps. Weighs less than 25 lbs. Size 18″ x 12″ x 10″. Extremely simple in operation.

A new rectifier unit as companion to this lamp is also available.

For sale by independent supply dealers

The Strong Electric Corporation
2501 Lagrange St., Toledo, Ohio
Export Offices: 44 Whitehall St., New York, N. Y.

PORTABLE TYPE REFLECTOR ARC LAMP

Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film
Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.

For sale by all Supply Dealers

Commission Issues Statement on C. S. "Coaching" Courses

The United States Civil Service Commission makes the following announcement:

Those who contemplate subscribing for a correspondence or other "coaching" course in preparation for an examination for the Federal civil service are advised by the United States Civil Service Commission to inform themselves in advance of the probability of the announcement of an examination of the kind for which the course of instruction is supposed to train them.

The Commission's registers of eligibles for most of the common run of positions are so large that the probability is that in most cases it will not be necessary to announce an examination in the near future.

The Commission is represented by a local board of civil-service examiners at the post office or custom house in each city in the United States which has a post office of the first or the second class. There are approximately 5,000 of these local representatives throughout the country. The local representatives are given current information regarding announced examinations and are prepared to answer inquiries regarding them.

Where to Obtain Information

Those who live in communities which do not have a post office of the first or the second class may be informed by writing to the United States Civil Service Commission at Washington, D. C., or to any of its district managers. The district managers have their headquarters at Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Washington, D. C.; Atlanta, Ga.; Cincinnati, Ohio; Chicago, Ill.; St. Paul, Minn.; St. Louis, Mo.; New Orleans, La.; Seattle, Wash.; San Francisco, Calif.; and Denver, Colo.

It should be understood that the United States Civil Service Commission has no connection with any so-called civil-service school or institute doing business by correspondence or otherwise. The Commission is in no way responsible for statements made in the advertising or correspondence of schools.

New Camera Demonstrated

A report received from Rochester, N. Y., states that there was recently demonstrated in that city a new motion picture camera which is capable of making 20,000 photographs per second.

The inventor of the camera is a Japanese. The mechanism of the device is so contrived that the speed may be adjusted to photograph bullets in flight. It is claimed also that the camera is capable of picturing the air currents created by an airplane propeller.

A message to the

Motion Picture Theatre Owners

of America

A most important announcement was delivered at the Allied States Convention in Detroit, and the M. P. T. O. A Convention in Washington by the Photophone Division of the RCA Victor Company.

It was at the same time the most important announcement exhibitors have heard since sound became the screen's most dominating factor.

Cut to the bone and right down to the solid facts, it is herewith transmitted to motion picture theatre owners of America, large and small, from the largest circuit to the individual exhibitor.

Before one or the other contemplates the installation or replacement of sound reproducing equipment, investigation of the following information is respectfully suggested:

The Photophone Division of the RCA Victor Company announces

The introduction of two new all AC operated sound reproducing equipments, the *Standard Super,* designed for theatres from 2,500 to 4,000 seating capacity at $5,000 and *Standard Large,* for theatres between 1,400 and 2,500 seating capacity at $3,750.

Reduction in the price of the Special Size equipment from $1,600 to $1,450. Other material reductions including contract service charges, all made possible by the recent merger of the RCA Photophone Co. with RCA Victor Co., Inc. Increases in capacity limitations of all A C operated Special Size equipment from 500 to 600 seats and all AC operated Standard Small Size equipment from 1,200 to 1,400 seats.

For further information communicate with

Photophone Division

RCA Victor Co., Inc.

Camden, N. J.—branch offices in principal cities

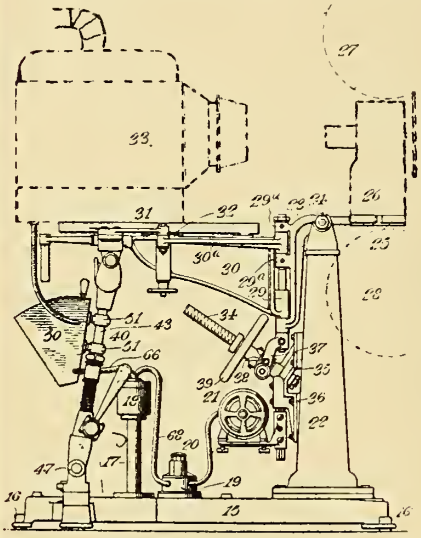
RCA VICTOR COMPANY, INC.
PHOTOPHONE
SYSTEM

TRADE MARKS REG. U. S. PAT. OFF.

◆ RECENT PATENTS ◆

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 230 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine, and enclosing fifteen cents to cover costs.

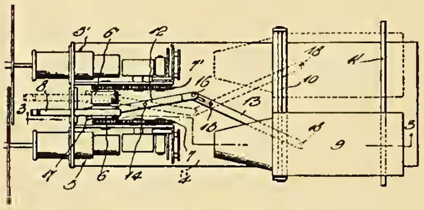
1,846,050. ELECTRICAL SWITCHING APPARATUS FOR PICTURE PROJECTION MACHINES. Augusto Dina, Jersey City, N. J., assignor to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed May 31, 1928. Serial No. 281,872. 4 Claims. (Cl. 88—17.)



1. In a motion picture projection apparatus comprising a base, a supporting pedestal and a rear bracing frame carried thereby, a switch supported by said base between said pedestal and said bracing frame in a position readily accessible to the foot of an operator and adapted to control the driving motor.

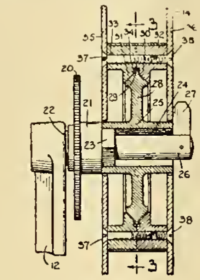
▲

1 844,946. MOTION PICTURE PROJECTING MACHINE. Louis Allen Doolittle, St. Petersburg, Fla. Filed Mar. 19, 1930. Serial No. 437,102. 4 Claims. (Cl. 88—17.)



4. In a motion picture projecting machine, a base, twin projectors secured to said base and disposed side by side, said projectors having individual driving pulleys axially alined and disposed above the base, a drive belt engageable with either of said pulleys and extending downwardly therefrom, belt-shifting lever mechanism mounted on said base, operatively connected with said belt and extending rearwardly from said projectors, a lamp box connected with the rear end of said lever mechanism, and means mounting said lamp box on said base for movement to an operative position behind either of said projectors, said lever mechanism insuring that simultaneously with positioning of the lamp box behind either projector, the belt will be shifted to drive said projector.

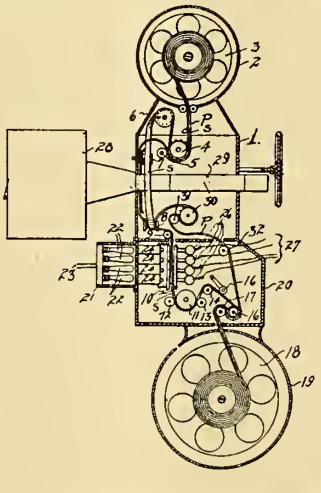
1,844,676. MOTION PICTURE WINDING APPARATUS. Freeman H. Owens, New York, N. Y. Filed Dec. 4, 1928. Serial No. 323,635. 6 Claims. (Cl. 242—55.)



1. A motion picture film reel comprising a hub adapted to be connected to rotary driving means, and a body portion encircling said hub, one of said elements having an annular channel, and the other of said elements having a circumferential bead disposed within said channel, said hub and body portion having additional engaging friction faces for the transmission of power to said body portion.

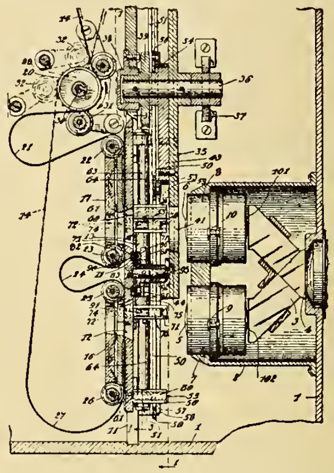
▲

1,843,972. TALKING MOTION PICTURE APPARATUS. Lee de Forest, New York, N. Y., assignor to De Forest Phonofilm Corporation, New York, N. Y., a Corporation of Delaware. Filed Sept. 28, 1928. Serial No. 309,076. 7 Claims. (Cl. 88—16.2.)



6. A talking motion picture apparatus, including in combination a supporting casing, two reels mounted in spaced relation to each other, a picture film and a sound photographic film supported by said reels, said films being in parallel convolutions, picture film progressing and projecting means mounted in the casing, a sound-on-film reproducing and progressing means also mounted in the casing, and mechanism mounted in the casing for separating the films so that the picture film and the sound film will move through their respective projecting and reproducing means separately and independently but in unison.

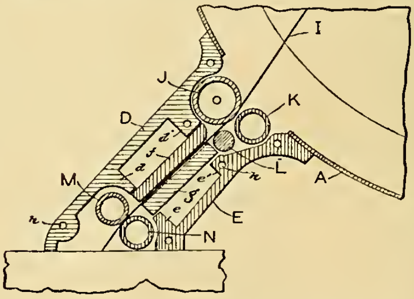
1,845,062. COLOR PHOTOGRAPHY. Andrew Schustek, Chicago, Ill., and Clifford Le Roy Treleaven, Jackson Heights, N. Y., assignors to Colorfilm Corporation, New York, N. Y., a Corporation of Delaware. Filed July 31, 1926. Serial No. 126,116. 15 Claims. (Cl. 88—16.4.)



1. In a camera of the character described having a single lift aperture, in combination, optical means related to said aperture for obtaining two geometrically like images simultaneously at focal plane areas spaced apart, separate means at each focal plane for intermittently advancing a film strip through said focal plane areas simultaneously, and means for maintaining a free lop of film intermediate said focal plane areas during said advancing of the film.

▲

1 845,840. MAGAZINE VALVE FOR MOVING PICTURE PROJECTORS. Arthur J. Holman, Boston, Mass. Filed Aug. 8, 1927. Serial No. 211,282. 2 Claims. (Cl. 88—17.)



2. In a magazine valve arranged to connect a film magazine and projector mechanism, the combination of a cast casing located exterior to said magazine and said mechanism, a plurality of rollers enclosed in said casing, said rollers having fixed axis of rotation and serving primarily the purpose of fixing the path of film through said magazine valve, and a pair of heavy metallic plates arranged and positioned to parallel the path of the film and to be in close proximity thereto throughout a large portion of said fixed path of said film.

As The EDITOR *Sees* IT

¶ *The S.M.P.E. Spring Meeting*

EARLY next month, from the ninth to the twelfth of May to be exact, there is scheduled to take place at Washington, D. C., an event that is of special interest and significance to every technical worker in the Motion Picture Industry. It is the Spring Meeting of the Society of Motion Picture Engineers.

At the time of this writing no formal announcement of the papers to be presented has been published, but reports indicate that the members of the Papers Committee are bending every effort toward the preparation of an interesting and unusually attractive program. A feature which is of direct concern to the projectionist is that the science and technique of projection will as always occupy a prominent place in the schedule.

These meetings of the Society are always well patronized by its members, but it is a fact to be regretted that serious-minded and ambitious members of the projectionist fraternity have not been more in evidence. It would hardly be just to attribute this to indifference. The truth probably is that several misconceptions have contributed to the situation.

Principal among these may be listed the belief that such meetings are restricted to members only. This is entirely erroneous. Every person interested in the work of the Society—and certainly this applies with special force to the projectionist—is not only invited, but urged to attend and to participate in the transactions of the Society by a free expression of his opinions. It is only in this manner that this or any other organization dedicated to scientific and technical advancement can accomplish its purpose to universal and best advantage.

Again, there is doubtless prevalent in the minds of many the notion that the proceedings of the Society are devoted to the discussion of abstruse and highly technical matters of little or no interest to anyone except the specialist or the advanced research worker.

It is undoubtedly true that some of the papers might with justice be assigned to this category, but considered by and large, the vast majority of the lectures—especially those devoted to purely projection subjects—are wholly within the grasp of any trained projectionist of normal intelligence. And they concern him and his work—let there be no mistake about that!

It is for this reason, if for no other, that every member of the craft who lives within a reasonable distance of the Capital and has the facilities for making the trip, should make every effort to take advantage of the opportunity. It means not only the gaining of a more satisfying knowledge of one's own particular profession, but also a broader and more complete conception of the problems, aims and purposes of the Industry as a whole.

¶ *Camera and Microphone Consciousness*

"A PLAY is said to be well or ill acted in proportion to the scenical illusion produced. Whether such illusion can in any case be perfect is not the question. The nearest approach to it, we are told, is when the actor appears wholly unconscious of the spectators." So, more than a century ago, Charles Lamb saw fit to observe in his celebrated *Essays of Elia.*

In its application to the modern motion picture, with its absence of spectators—or, as one might better say, audience—during the recording of voice and action, the final sentence of the foregoing quotation is of peculiar interest.

In the filming of the old style silent picture, with the morale of the cast sustained by ad lib. instructions from the director, the phenomenon was not so much in evidence; but with the coming of sound, self-consciousness, stage consciousness, or, to give it its new name, microphone consciousness, returned with all its pristine vim and vigor.

And more, it is not confined to the motion picture field, but constitutes a formidable problem in radio broadcasting. Even the political ballyhoo artist, with years of experience in public speaking to his credit, has been known to flinch when confronted by the microphone.

Since the addition of booth microphones to many of the modern theatre amplifiers, it would be of more than passing interest to know the reactions of the projectionist upon his induction to the ranks of the afflicted.

¶ *George Eastman*

IN view of the widespread publicity following the death of Mr. George Eastman, it seems almost superfluous to mention it here. However, there are few professions that owe more to one man than the projectionists owe to the founder of the Eastman Kodak Company. The motion picture today would indeed be but a sorry thing were it not for Mr. Eastman and his narrow ribbon of celluloid.

Perhaps no finer tribute may be paid to the genius of the man than that which rests in the fact that today, after more than a quarter of a century of progress in the commercial motion picture field, no practical substitute has yet been discovered for the film base as given to the world by Mr. Eastman himself.

CHARLES E. BROWNELL.

Rotating Electrical Machinery

By William H. Haines

The electric motor and the electric generator in their various forms find many applications in the field of motion picture projection. In the survey which follows, the author considers some specific types of rotating electrical machinery and describes their peculiar suitability for the work assigned to them. This equipment review is supplemented by some timely and helpful suggestions for the installation and care of the apparatus. Mr. Haines is associated with the Sales and Engineering Departments of the Electric Specialty Company of Stamford, Conn.—The Editor.

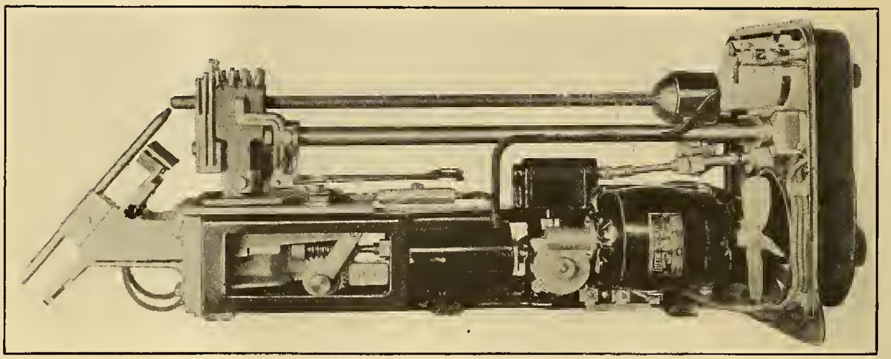


Fig. 2. Electrode Feed Assembly Showing Motor

SINCE the early days of the motion picture, rotating electrical machinery has played an important, and in fact an indispensable, part in the science. Today, more than ever before, the efficiency of projection equipment is due largely to the smooth and uninterrupted performance of such apparatus. The types are numerous and varied, ranging from projector drive motors to heavy duty arc generators. In the present discussion an effort is made to furnish in a general way a survey of the field, giving a short description of each type of motor or generator and its appointed function in the scheme of modern projection.

Synchronous Motors

Synchronous motors are used in many theatres for operating projectors employing sound-on-film and sound-on-disc equipment. The advantage of the synchronous motor as compared with the ordinary induction motor is its ability to operate a projector at exactly constant speed, even though the supply voltage may vary through wide limits. In cases where the supply voltage is constant and steady, the ordinary induction motor may operate satisfactorily. There are many cases, however, where the use of synchronous motors insures very much more satisfactory operation than could be obtained from the induction motor.

There are two types of single phase synchronous motors used on projectors. The type first and most frequently used is the split phase start motor. This motor is furnished with a separate winding which supplies the necessary power at starting. This winding is not heavy enough to be connected to the line continuously and is disconnected from the line by means of a centrifugally operated switch as soon as the motor comes up to speed.

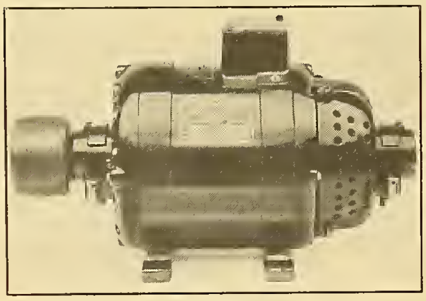


Fig. 1. Synchronous Motor (Commutator Type)

The second type is the commutator type synchronous motor which starts as a repulsion motor, the power being obtained from the commutator and brushes. This type of motor is furnished with a squirrel cage winding, similar to that of the induction motor, in addition to the repulsion motor winding, and as soon as the motor comes up to speed no current is carried by the brushes or the commutator, all of the power being generated in the squirrel cage winding.

Although the commutator type motor is somewhat larger and costs more than the split phase type, it has great advantages. It draws very much less current at starting and is therefore very much more acceptable to the electric light companies. Also, the efficiency is very much higher so that it draws much less power and saves the theatre operator in cost of power. As a matter of fact the saving in power costs should compensate for the additional first cost of the motor as compared with the split phase motor in less than a year's time.

These motors are usually furnished with either wool packed or wick oiled sleeve bearings. The wool packed bearings require less frequent lubrication but the wick oiled bearings, which are lower in cost, are entirely satisfactory if given proper attention. Motors with sleeve bearings run more quietly than those with ball bearings.

Motors for Arc Feed

Small D.C. motors operating from the voltage across the arcs of projectors and spotlights are being used very successfully for automatically feeding the electrodes at the proper speed. These motors operate from the voltage across the electrodes of the arc. If the electrodes are too far apart this voltage increases, increasing the speed of the motor, thus increasing the speed of feeding the electrodes and decreasing the distance between them.

In practical application a resistance, which is called the potentiometer, is connected across the terminals of the arc. On this resistance there is an adjustable center tap which is connected to one lead from the motor armature. The other motor armature lead is connected to one electrode which is the same as one end of the resistance. Only part of the arc voltage is thus used to operate the electrode feed motor.

Purpose of Arrangement

This is done to provide a manual adjustment of the speed of feeding the electrodes to take care of differences in operating conditions and different types of electrodes. In some cases the shunt field of the D. C. motor is connected directly across the arc and the armature is connected to the potentiometer sliding contact. In other cases both the shunt field and the armature of the motor are connected to one side of the arc and to the sliding contact of the potentiometer rheostat.

This arrangement is used for both projector and spotlight arcs. In each case four leads are brought out from the motor, two from the shunt field and two from the armature. In some cases additional control is provided by the use of a thermostat which connects a resistance in series with the armature of the motor, thus decreasing the speed of the motor if the electrodes should become too close together.

Motor-generators designed especially for the requirements are being used very satisfactorily for furnishing low voltage D. C. to exciter lamps, field circuits of loud speakers and the filaments of vacuum tubes used in the amplifiers. If the machines are suitably designed no filters are necessary when furnishing current to the field circuits of the loud speakers.

When furnishing current to exciter lamps electrolytic condensers of about 4,000 mfd. may be used connected directly across the terminals of the generator to prevent hum. In furnishing filament supply to the amplifier tubes special filters are required, but they may be furnished in compact and convenient form. The supply to the filaments of the photoelectric cell amplifier or the head amplifier, as it is often called, must be filtered more carefully than those of the main amplifier.

The D. C. supply for the photoelectric cell is so small in amount that it is usually advisable to use a B battery for this purpose. Single motor-generators, however, may be used for taking care of all the remaining low voltage D. C. required. Filters for the exciter lamps and vacuum tube filaments may then be furnished in a convenient box, a separate filter circuit being provided for each of the D. C. circuits required.

In most cases there are two exciter lamps and two head amplifiers, in which case each should be provided with separate filters. This is necessary so that constant voltage may be available at the exciter lamp and tube filaments, whether one lamp or two are being operated. Motor-generators may be furnished to deliver constant voltage with changes in load and if separate filament circuits are provided, the same voltage will be available during the change-over periods when two lamps are in operation as during normal operation with only one lamp.

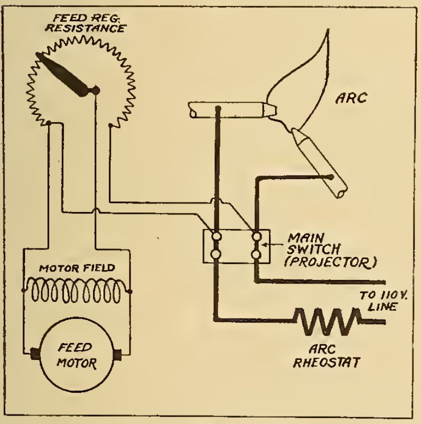


Fig. 3. Arc Feed Motor Connections

M. G. Sets for Plate Supply

In many cases a D. C. plate supply voltage of 350 volts or higher is required for the amplifiers. Motor-generators are the most reliable and satisfactory source of power in this case. Machines of the same mechanical construction as the small motor-generators with low voltage output described above are used. The generators are carefully designed so that the output voltage is comparatively free from fluctuation.

A carefully designed filter is then used which prevents any hum from coming through to the amplifiers. The filter is generally furnished separately and in some cases meters and rheostats are included in the filter box, arranged for wall mounting.

D. C. to A. C. Converters

In many theatres nothing but D.C. supply is available and as the most satisfactory equipment requires A.C. for its operation, machines to convert D.C. into A.C. are quite necessary in these cases. If the A.C. amplifiers are the only equipment requiring A.C., rotary converters with filters may be used. In some cases the meter and rheostat, together with the filter are mounted in the base of the converter.

These machines are small and compact as compared with the power which they deliver and give very satisfactory service. When machines of suitable design and properly designed filters are used there is no perceptible hum in the loud speakers. Machines with protecting covers over commutator and collectors should be used and machines designed especially for continuous operation are necessary.

If A.C. synchronous motors for driving the projectors are to be operated in a theatre where only D.C. is available a motor-generator set rather than a rotary converter is recommended because it will deliver much more constant voltage and frequency with variations in load. During the change-over period one projector motor must be operated while the second motor is being started up. Synchronous motors, especially those of the split phase type, draw a considerable current at starting and starting of the projector motor causes a considerable overload on the generator. A motor-generator with compound windings will take care of this condition nicely, whereas the voltage delivered by the rotary converter under these conditions would not be steady enough.

Speed Regulated M. G. Sets

In installations where the line voltage fluctuates badly and where A.C. projector motors must be operated, motor-generator sets with special centrifugally operated automatic speed regulators are necessary. The automatic speed regulator automatically maintains the motor speed constant by changing resistance in its field. The generator is then furnished self-excited and the frequency and voltage output is thus made independent of variations in the D.C. supply voltage. Such machines are of course considerably more expensive than rotary converters or motor-generators without the automatic feature. They are necessary, however, under certain operating conditions.

The most dependable method of charging storage batteries is by means of a motor-generator set. The characteristics of a shunt wound electric generator are ideal for battery charging, as far as the changes in voltage and current required to charge the battery during the charging period are concerned. Ruggedly designed motor-generators of liberal rating require very little attention. If any trouble does develop due to parts wearing out they may be very easily replaced by any mechanic. Also the battery charging motor-generator is very flexible and may be adapted easily to different operating conditions.

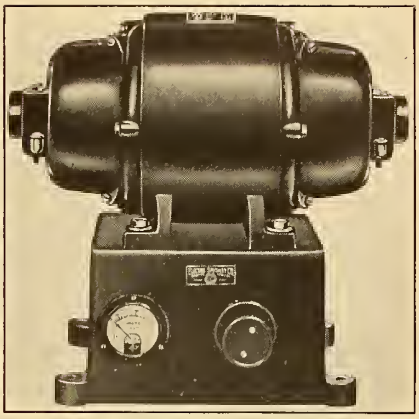


Fig. 4. Rotary Converter for Amplifier Supply Service

Control Panels Used

Panels or panel boxes are used with meters showing the rate of charge or discharge and voltage and a rheostat is provided for adjusting the charging rate. A reverse current relay is also provided to prevent the battery from discharging through the generator circuit if for any reason the generator should fail to deliver voltage such as failure of motor supply line. The relay automatically reconnects the generator to the battery as soon as the proper voltage is again delivered by the generator.

In locations where the power supply is uncertain and subject to frequent interruptions a gasoline engine driven generator set may be installed for stand-by service. Sets are obtainable with A.C. generators which may be provided with filters and which will furnish power for A.C. amplifiers, synchronous motors, etc. Special mufflers are usually required

(*Continued on page* 30)

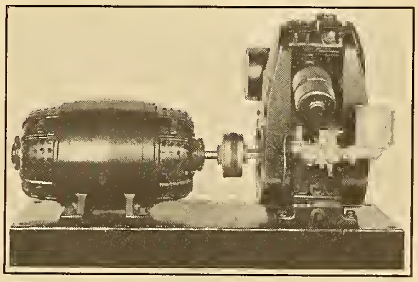


Fig. 5. Gasoline Driven Stand-by Unit. (A.C.)

The Advantages of Push-Pull Amplification

By Albert Preisman

Although the theory underlying push-pull amplification is comparatively simple to understand, it is a fact well known to instructors and others who have had occasion to question even graduate engineers on the subject, that there are many technically trained men to whom it is not entirely clear. Inasmuch as the push-pull principle is employed extensively today in the amplifier units of theatre sound equipment, it is singularly fitting that Mr. Preisman has chosen the subject for discussion in the article which follows. Mr. Preisman is an electrical engineer of broad technical experience. He is a graduate of Columbia University and is at present a member of the teaching staff of RCA Institutes.—The Editor.

ALTHOUGH numerous amplifier circuits have been brought out from time to time which are departures from generally accepted practice, there is one type of circuit that has been accorded a steadily increasing popularity since its invention and introduction to the field. Today it is more firmly entrenched in technical favor than ever before. We refer to the push-pull circuit.

Therefore, in spite of all that has been written about this type of amplification, it will not be amiss to describe this circuit once again, and point out its many superior features. Many of these are not generally known even to the average engineer, but are, nevertheless, of great importance.

In the early days of the art, if more power was desired from an amplifier, there were two means of obtaining it. One way was to double up on the number of output tubes used, *i.e.*, connect another tube in parallel with the first. This meant that the two grids and the two plates were connected together respectively. In operation, the pair of tubes functioned practically as one tube of twice the dimensions and hence twice the power output.

The second method was actually to use a larger tube. This, however, is essentially the same as using two tubes in parallel, at least from a theoretical viewpoint.

The push-pull circuit was invented by Colpitts. Basically, the arrangement was such that the grids of the two tubes acted opposite to each other upon their respective plate currents, and the latter were so coupled to the load as to have an additive effect. The net effect was that the two tubes acted as if they were connected in series to the load, much like two locomotives coupled to a freight train.

Circuit Employed

In order better to understand the operation of this system, let us examine the circuit employed. (Figure 1.)

Two tubes, 1 and 2 are employed, together with an input transformer "A," and an output transformer "B." As can be seen from Figure 1, the secondary of "A," and the primary of "B" are center-tapped. The signal—from whatever source we desire—is fed into the primary of "A." An alternating voltage is induced in the secondary. If we ground the mid-point, as shown, then at one instant, the end connected to the grid of Tube 1 will be positive with respect to ground, and simultaneously, the other end, connected to the grid of Tube 2, will be negative with respect to ground. A half cycle later, conditions will be reversed. The grid of 1 will be negative, and the grid of 2 will be positive with respect to ground.

Let us suppose for the moment, that the filaments are connected in parallel and grounded at the mid-tap of their supply. Then, when one grid is positive with respect to the filaments, the other will be negative, since these are their potentials with respect to ground, and both filaments are grounded.

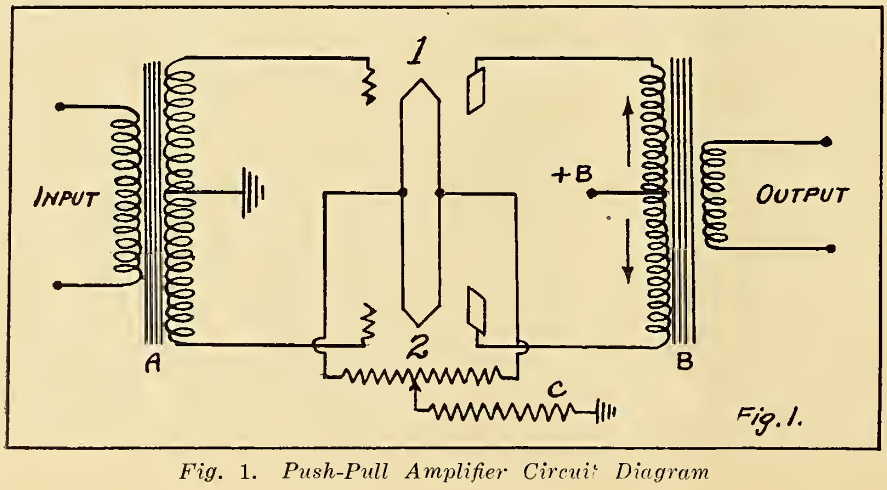


Fig. 1. Push-Pull Amplifier Circuit Diagram

The plate current of the tube whose grid at that moment is positive with respect to the filament, will increase; the plate current of the other tube will decrease, because its grid at that moment is negative with respect to its filament.

It will be noted that the plate current is fed to the primary of the output transformer "B" through its center tap. The two arrows show the direction of the current to the plates of the two tubes. It can be seen from the arrows that the two currents are opposite. As long as the currents are steady (direct current), the flux produced by either will be steady. However, if the two currents are equal, the flux produced will be zero, since the currents flow in opposite directions through the primary windings, and nullify each other magnetically.

Effects Additive

If the current to Tube 1 increases for instance, its flux increases. This change in flux induces a voltage in the secondary of "B" in the direction, let us say, toward the top of the drawing. Now if the current to Tube 2 decreases, it will not "buck" the current going to Tube 1 as much as before, so that the latter current can produce more flux than it otherwise could. The result is that the flux change will be greater than before, and the voltage in the secondary of "B" will be increased. Thus, an *increase* in the current to Tube 1, or a *decrease* in the current to Tube 2, will each induce a voltage in the *same* direction in the secondary of "B," *i.e.*, the current changes are additive in effect, and one current change is just as effective as the other in inducing voltage in the secondary. Thus, the two tubes act in series, as far as the secondary is concerned, since their voltage inducing effects in the secondary are in the same direction and hence additive.

When the grids of the two tubes assume polarities opposite to those assumed above, the current in Tube 1 *decreases*, and that in Tube 2 *increases*, and a voltage is induced in the secondary in the opposite direction but, nevertheless, the two tubes are still additive in their effects.

In this way twice the alternating voltage is induced in the secondary by the two tubes as compared to that which one tube alone could produce, so that the two tubes at all times act in series. By a similar method of reasoning it can be seen that the internal plate resistances of the two

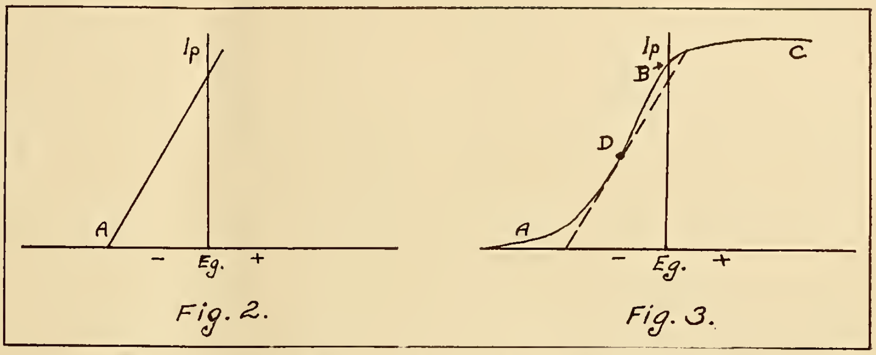


Fig. 2. Fig. 3.

Plate Current: Fig. 2. Ideal. Fig. 3. Actual Condition

tubes are in series, so that we have twice the plate voltage of one tube acting through twice the plate resistance of one tube to feed current into the output transformer and load.

Application of Bias

So far we have considered the circuit as operating without any grid bias, *i.e.*, if no signal is impressed upon the grids, they are at ground potential, and hence at the same potential as the filaments. By inserting resistor "C" between the center tap of the filament supply (here obtained by means of a potentiometer and ground, the plate currents, in flowing back to the filaments, have to pass through "C," and cause a voltage drop in it of such direction as to make the filaments positive with respect to ground. Since the grids are normally at ground potential, they are now negative with respect to the filaments, that is, have a negative bias with respect to the filaments. Resistor "C" is thus the well-known grid biasing resistor, only a by-pass condenser is not usually connected in parallel with it, as will be explained later.

In this arrangement, if one grid receives a positive voltage from the incoming signal, its negative bias is reduced. The other grid simultaneously receives a negative voltage from the incoming signal, so that its negative bias is increased. The signal must be below the value that would make the first-mentioned grid go actually positive with respect to the filaments, or the other grid go so negative that the plate current is reduced to zero before the grid has reached its lowest negative value. These limitations to signal strength are exactly the same as those for a single tube amplifier operating without distortion. In short, a push-pull amplifier does not work the tubes any more completely than an ordinary amplifier, so that each tube delivers the same output in either case. Hence the output of the two tubes in push-pull arrangement is approximately twice that in a single tube amplifier, and not three to four times as much, as claimed by various enthusiastic manufacturers.

Output Power

So far it would appear we have gained nothing by putting the tubes in push-pull arrangement instead of in parallel. Indeed, the transformers used require center taps, and hence are apparently more expensive to manufacture than those used in the ordinary cascade amplifier. Indeed, if there is greater capacity between the turns of one-half the secondary of "A" than the other, the phase between the voltages applied to the two grids will not be the same, *i.e.*, the voltages applied to the two grids will not go through their maximum values simultaneously.

A similar effect may be obtained if the leakage reactance between one-half of the primary of "B" with respect to the secondary is not the same as that of the other half. In either case the output will not be twice that of one tube, but somewhat less, depending upon the phase angle between the two voltages, so that the full benefit of the two tubes is not realized.

Advantages of the Circuit

Nevertheless, this circuit has so many important advantages that the above consideration is of little comparative consequence. In the first place, examination of Figure 1 shows that the steady or average value of the D. C. current of either tube (as measured by a D. C. milliammeter), flows in a direction through its half of the primary of "B" opposite to that of the plate current of the other tube. Thus, if the tubes have nearly equal plate currents, they practically balance each other magnetically, and produce little or no steady (D. C.) flux in the core of "B." Thus, the core can be made smaller without any danger arising of its becoming saturated, and the importance of this may be appreciated when it is realized that the plate current of either power tube is quite large and would saturate even a larger core if present there by itself. Of course, on the other hand, care must be taken in operation to see that the plate currents are nearly balanced, otherwise saturation will occur. As an example in a certain output transformer designed for use with two UX-245 tubes, the difference between the two plate currents must not exceed five milliamperes. In the case of large tubes, they are arranged so that the grid bias of each may be adjusted independently, so that the plate currents can be matched.

The second advantage—that of cancellation of the second harmonic, is more generally appreciated. To demonstrate this effect, we shall refer to Figures 2, 3 and 4. In Figure 2 we have plotted the variation in plate current Ip with that of grid voltage Eg for an ideal tube. In such a tube the plate current (measured along the vertical axis) is strictly proportional to the grid voltage (measured along the horizontal axis), and the graph is a straight line, because only in the case of a straight line is the rise in proportion to the distance along the horizontal direction. In particular, if the voltage applied to the grid were of sine wave in shape, the variation in the plate current would be sine wave in shape.

In practice, however, tubes do not have such ideal characteristics. Instead, the graph is that shown in Figure 3 (solid line). Here, as the grid voltage is increased from a negative direction, as it reaches the value at point "A," the plate current begins to rise rapidly, but still not as abruptly and sharply as in Figure 2, "A." Thereafter, it increases up to the value "B" at a rate faster than the increase (in a positive direction) of the grid voltage. From "B" to "C" the plate current begins to taper off until finally it ceases to increase, and may even decrease.

The reason is that all the electrons emitted by the filament are now all drawn to the plate, and the current can increase no further, as the quantity of electrons are limited by the filament. Furthermore, if the grid potential be increased to a value greater than that of the plate, it will rob the plate of electrons, so that the plate current will then decrease.

Normal Operating Range

We are interested, however, in the values of plate current between points "A" and "B," as this represents the normal operating range of the tube. An ideal tube would have the characteristic or graph shown by the dotted straight line in Figure 3. From this we can see that if the normal value of plate current in the actual tube is "DE," then if the grid increases positively, the plate current is greater than that proportionately as the graph is above the dotted ideal line at "B."

On the other hand, if the grid becomes more negative, the plate current does not decrease as rapidly as it should for strict proportionality, that is, its graph is here too, at "A," above the dotted line. Hence, if a sine wave of voltage is impressed upon the grid, the plate current will not be sine wave in shape, but the positive half cycles, or alternations, will be peaked, and the negative alternations will be flat-topped. This is shown in Figure 4. The solid line gives the actual wave shape of the plate current, and the dotted line the ideal, sine wave shape desired.

Now, referring to a push-pull amplifier, the plate current of one tube is going through a positive alternation when that of the other tube is going through a negative alternation. Since the currents in the two tubes are additive in their effect of inducing voltage in the secondary of the output transformer, it is evident that since one current is peaked, and the other flat-topped, the *excess* of one is balanced by the *deficiency* of the other, and their combined effect is to induce more nearly a sine wave of voltage in the secondary. This can be checked by shifting the negative alternation under the positive one in Figure 4 so that their ends coincide, and adding together corresponding vertical distances. The result will be a curve of approximately twice the height of either, and practically sine wave in shape.

Thus, by causing the plate currents of the two tubes to vary oppositely to each other, the distorting effect of one is balanced by the oppositely distorting effect of the other, and the net result is more faithful amplification. The distortion of either tube consists mainly of the second harmonic of the sine wave to be amplified, and it is this harmonic that is practically eliminated by a push-pull amplifier. Note that if the two tubes were in parallel, their plate currents would both simultaneously increase and decrease, so that no cancellation of the second harmonic could occur. Also, it is to be noted that both plate currents would flow through the same primary in the same direction, so that the D. C. or steady flux would be doubled instead of cancelled, as is the case in the push-pull amplifier.

Plate Current

Since when the plate current of one tube is increasing, that in the other is decreasing, the sum of the two is practically constant, so that there is no audio component flowing into the center tap of the output transformer —"B," Figure 1. This means that the last condenser in the plate supply filter circuit does not have to be so large, since it does not have to by-pass a large audio component coming from the power tubes. Also high regulation of the plate supply voltage has no bad effects, as it would on a single power tube, or two connected in parallel. Furthermore, since there is no appreciable audio component flowing through the grid biasing resistor, it does not have to be by-passed with a condenser, and this, too, represents a considerable saving, since for power tubes the plate current is large, the grid biasing resistor is low, and therefore otherwise has to be by-passed with a large condenser.

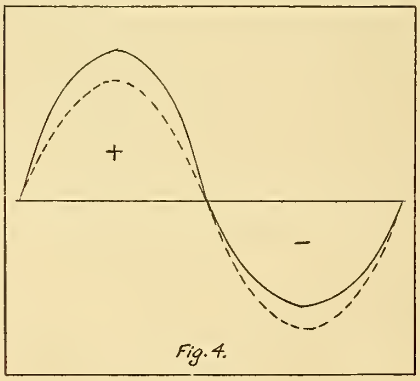


Fig. 4.

Actual and Ideal Wave Shape

Equalizing Effect of Grid Bias Resistor

It was stated in the preceding paragraph that the increase in plate current in one tube was balanced by the decrease in the other, so that the total plate current is constant. This is, however, not strictly so, for it will be remembered that due to the curvature of the tube characteristic, as shown in Figure 3, the increase in plate current is greater than the decrease for equal and opposite grid voltages. Consequently, there is a second harmonic current of small magnitude—flowing in the circuit, and in particular, through the grid biasing resistor.

Now, in general, an increase in plate current tends to increase the grid bias, and thus depress the grid voltage, and consequently decrease the plate current. In other words, as the grid tends to increase the plate current, the latter tends to prevent this through its action on the grid biasing resistor. This is known as degeneration, and is the reason for the large by-pass condenser across the resistor in single tube amplifiers.

In a push-pull amplifier, however, this opposing effect of the plate current of the tube on its own grid potential is an aiding effect upon the grid of the other tube, since that grid is swinging in potential in the opposite direction. Hence, each tube has a degenerating effect upon itself, and a regenerating effect upon the other tube.

The net consequence of all this is that the second harmonic current mentioned above, in flowing through the grid biasing resistor, tends to reduce the peak of the positive alternation of the one tube, and to peak the flat-topped wave shape of the negative alternation, and so tends to destroy itself. As a result, the second harmonic is even further wiped out, in addition to the cancelling effects of the two tubes, as described previously.

There is another beneficial effect due to this action. If one tube is stronger than the other, *i.e.*, if the change in its plate current is greater than that in the other tube for the same grid swing, then the excess current will flow through the grid bias resistor, and cut down the excess current of the stronger tube, and raise that of the weaker tube, thus equalizing their outputs. Thus the grid bias resistor tends to make the mutual conductances of the two tubes more nearly equal.

It is evident that if the plate supply current, coming in through the center tap of the output transformer, increases, it increases in both halves of the primary. The two halves therefore induce equal and opposite voltages in the secondary, or no net voltage at all. The same argument holds for a decrease in plate supply current. Hence, if the voltage supply is not very perfectly filtered, no hum will be heard in the loud speaker anyway. A similar argument holds if there is a ripple in the grid bias voltage, or even filament supply, so that the push-pull amplifier is much more free from hum than the single tube or parallel tube type of amplifier.

Summary of Advantages

We may now summarize the advantages of the push-pull amplifier:

(1) Saturation of the core of the output transformer is minimized.

(2) The second harmonic component in the output wave shape, due to the curvature of the tube characteristic, is practically eliminated.

(3) When no by-pass condenser is shunted across the grid bias resistor, further cancellation of the second harmonic component is obtained, as well as equalization of the tube outputs.

(4) Ripples in the power supply tend to cancel out in the push-pull circuit, so that it is quieter in operation, or, for the same hum level, requires less filtering of the power supply.

New Stereoscopic System Developed in France

A new system of stereoscopy is announced by the French newspaper *Paris-Midi*. The invention has been kept a strict secret, but it is said to be based on the filtration of light rays through multiple lenses. Only the eight experimenters are said to know the exact details of the system, researches having been conducted in a secluded laboratory. More than twenty patents have been taken out as protection.

Painter Invents Screen

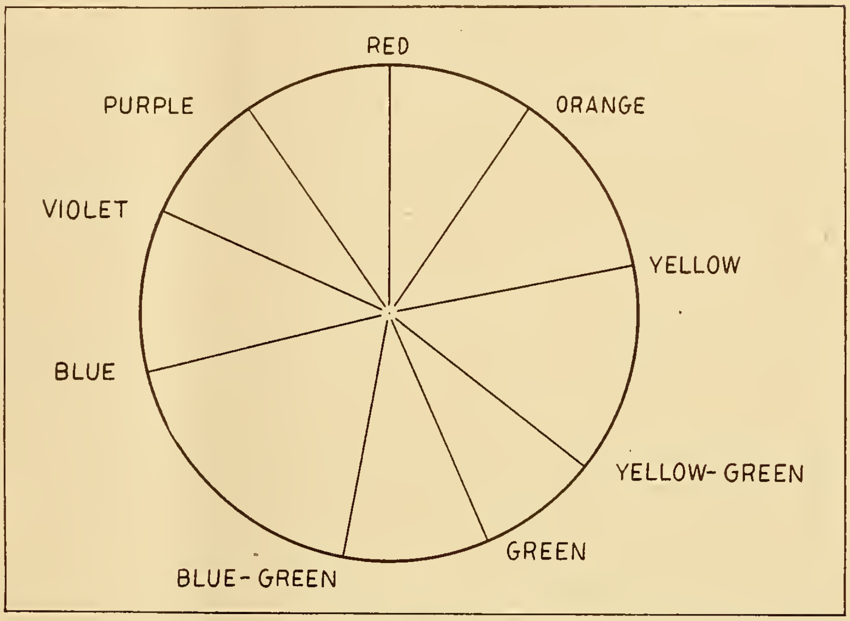
John Crawford, a painter and decorator, of Newburgh, N. Y., has been assigned a patent on a new motion picture sound screen. The screen is reported to be of the perforated type. According to a statement quoting the inventor, the new product differs from others in that a process has been devised for coating it in such a manner that it is covered with thousands of tiny "lenses" which afford reflection and depth.

Painting the Silver Sheet

By John L. Cass

Part IV: Three-Color Process and 16 mm. Color

Color has been referred to by Mr. John I. Crabtree, retired president of the S.M.P.E., as the only immediately available variant from the prevailing black and white picture, and its further development is anticipated by leaders of the Industry as the next outstanding technical achievement. The following article from the pen of Mr. John L. Cass, assistant chief engineer of RCA Photophone, marks the fourth and last of the series contributed by the author on this important subject. Mr. Cass is particularly qualified to discuss the application of color in motion picture science, his engineering experience having embraced many years of research in the color picture field.—The Editor.



The Color Circle

IN the preceding articles on the subject of color, it may be noted that all of the methods described have produced "two color" prints. This means that the spectrum has been divided arbitrarily into two parts in producing the color separation negatives, while the resulting prints have been tinted in two shades, corresponding to the original division. This does not mean that the images produced in this manner are limited to two definite colors, but means that they are limited to the shades which may be produced by varying proportions of these two colors.

Three-Color Problems

Since it is well known that three primary colors must be used in order to produce any desired shades, the reader may well wonder why the two-color method has been used, in view of its obvious shortcomings. The answer lies in the closely related factors, difficulty and cost. It has been said that the problem increases as a power of the number of separations used, meaning that two color is four times as difficult as monochromatic black and white, and that three color involves nine times the ordinary difficulty. In general, some such relationship does exist, and the cost should vary in somewhat the same proportion.

The advantages of true three color rendition have been apparent, and have inspired a great deal of development work toward that goal. It may be assumed that the normal progress in the art will eventually produce satisfactory three color motion pictures, the effect of which may be of tremendous importance. It is quite possible that true natural color would have a psychological effect upon the spectators which would render obsolete the existing photographic methods, even as electric recording displaced the older acoustic methods.

Three color adds to the problems both in photographing and in reproducing. It is probable that any successful three color process will be composed of the best elements of several of the existing two color methods, or upon some radically new principles not disclosed up to the present time. It is futile to guess what form the process of the future will take, but it is probable that the imbibition method of producing prints will be an important element.

This probability is based upon the obvious step of adding the third color to the print by means of a third matrix, without changing the physical characteristic from that of the two color imbibition print. The method which will be used in producing the three color negative separations is not apparent to this interested observer, but one may conjecture that it will take the form of a somewhat more bulky camera which will consume three times the negative footage as in black and white, as against the factor of two in two color.

It is of interest to note that one of the earliest processes produced three color images of relatively high quality. In this method, the three images were projected separately, registration being accomplished upon the screen through mechanical adjustment of the projectors. This method was demonstrated on a laboratory scale, but was not marketed due to the obvious impossibility of carrying out such control methods in every projection room. The usual separations in three color work are obtained through the use of red, green and blue-violet filters. In producing subtractive prints from separations made in this manner, the corresponding positive images must be colored blue-green, magenta and yellow. The reversal of color in three color is somewhat more complex than in two color. In essence, the positive color must pass those colors not passed by the corresponding negative filter. If this general rule is followed any one of a number of combinations may be used for true color reproduction.

There is one important color method which has not been mentioned up to this point. This postponement has been intentional, and has been for the purpose of segregating the subject into definite sections. The process in question is the lenticulated film method as presented by the Eastman Kodak Company in Kodacolor. This process has had commercial significance only in the 16 millimeter field, and so may be described opportunely at this point.

In considering professional processes, it was pointed out that the photographic method and the reproducing method do not necessarily have a definite relationship. In the case of the lenticular method, the two steps go hand in hand.

The Lenticular Method

The light which passes through the lens in the camera is divided into three sections by means of three-color filters interposed in the vicinity of the lens. The cone of light which strikes the film is thus composed of three sections of different color which strike the film at three different angular segments. The lenticular elements are moulded in the celluloid base, which is toward the lens.

Upon striking the lenticular elements, the three color sections are refracted in such a manner that extremely narrow color strips are produced in the panchromatic emulsion layer. Thus each element produces three strips which represent the color separations of that particular portion of the image. These strips register as ordinary exposures, in themselves without color value. The process of development is unusual, in that the exposed particles, after development, are bleached out, the film is reexposed evenly, and the remainder of the silver is developed in a second developing bath.

This reversal treatment is well known in ordinary 16mm home photography, in which the original negative becomes the projection print. In the case of Kodacolor, a similar set of filters is placed on the projection lens, the light from the projection lamp passes through the film and filters to the screen, and the original colors are synthesized on the screen, through exact reversal of the photographic optical paths.

This very ingenious method of producing color on the screen is the only one which has proved practical in the hands of the amateur. It is capable of producing true three color rendition, and is relatively inexpensive. The question comes to mind as to its possibilities for professional use. There are a number of factors which must be considered.

Limiting Factors

The size of the color elements is important. The lenticular elements must be produced mechanically, and must be accurate in contour. From a practical standpoint, this is limited, but they may be made small enough to stand the relatively low magnification in 16mm work. There is a serious loss of light in projection, which tends to keep the size of the projected image at a low value, thus aiding in the size difficulty. When given normal theatre magnification, the images of the color strips become noticeable, and detract from the quality of the result.

Difficulty has been encountered in producing prints from an original made in this way, without a serious loss in definition. This may not be an insurmountable obstacle, and several experimenters have claimed satisfactory methods, but the difficulties are considerable. The most bothersome difficulty in adapting the lenticular method to general theatre use is the necessity for special attachments to the projector. There are optical difficulties when the focal length of the projection lens differs from the focal length of the camera lens, since the cone of light rays must be the same for proper rendition. Color film and black and white film cannot be interspliced.

Because of these obstacles, lenticular film has not enjoyed professional approval except in the 16mm field to which it is peculiarly applicable. Similarly, the processes which have been used in theatre work have not been applied to 16mm because they are not adaptable to amateur operation, and because of the excessive cost involved in producing single prints. However, any color process may be used in producing library prints for sub-calibre projectors, the controlling factors being cost and scope of the market.

Spicer Dufay Method

An interesting process has been devised in England, known as the Spicer-Dufay method, which appears to have all of the inherent possibilities of the lenticular method, with some added advantages. In this method, the color separations are obtained through the use of a three color line screen produced in the celluloid in a most ingenious manner. In this case, no special apparatus of any kind is needed in photographing or in projection. The original film may be reversed and used as a print, as described earlier. The duplicating problem is identical with that in the lenticular method, and the inherent light loss is the same. However, this film may be interspliced with black and white.

In conclusion, certain characteristics are outstanding in the color field. There is an undeniable allure in the prospect of "painting the silver sheet" in better and better hues. Since the attraction has been so obvious to everyone, it has been a lucrative field for stock promotion. There are innumerable processes which have not been described in these articles, some of which have certain points of merit, but most of which have little to recommend them. Many millions of dollars have been invested in color processes which have had inherent weaknesses, but which appeared plausible to the uninformed. It is suggested that certain tests be applied to the unknown process before investment, and it is hoped that these articles may have suggested the practical viewpoint which should govern in considering suggested color methods.

The Speed Triple-Twin Tube

A NEW super output tube, developed by Cable Radio Tube Corp. and introduced under the trade name Speed "Triple-Twin," has lately been receiving much consideration from sound technicians and others engaged in public address, theatre amplifier and quality radio reproduction work.

This tube achieves its amazing efficiency from the utilization of positive as well as negative swings on the grid of its output section, together with the automatic compensation employed, for the consequent grid current flow in this section.

It consists essentially of two separate sections directly coupled within the glass envelope, an input or driver section and an output or driven section. Its input section is of high impedance and its output section of low impedance, being similar in these respects to regular output triode characteristic.

The frequency characteristic of the Speed "Triple-Twin" tube and its associated circuit is excellent. The Power vs. Frequency curve is flat within —2 db from 60 cycles to 50,000 cycles and is down only 5 db at 20 cycles.

An output of 4½ watts is obtainable from the Speed "Triple-Twin" type 295 with an applied signal of 5 volts RMS at 250 volts plate potential. This rating is very conservative as approximately 6 watts may be obtained from the tube without objectionable distortion.

An output of 14 watts is obtainable from two Speed "Triple-Twin" type 295 operated in push-pull with an applied signal of 7½ volts (RMS) at 250 volts plate potential. The characteristics of this tube are as follows:

Triple-Twin Tube Characteristics

OUTPUT TUBE

Heater Potential	*Volts*	2.5
Heater Current	*Amperes*	4.0

AMPLIFIER		*Input Section*	*Output Section*
Plate Potential	*Volts*	250	250
Grid Potential	*Volts*	—14.0	—3.0
Plate Current	*M. A.*	4.0	52.0
Plate Impedance	*Ohms*	12,000	3 000
Amplification Factor		14.4	13.0
Mutual Conductance	*Micromhos*	1,200	4,350
Load Impedance	*Ohms*	12,500	4,000
Undistorted Power Output	*Watts*	..	4.5
Grid Signal (for full power)	*Volts RMS*	5 0	..

Recent Activities in the 16 Mm. Field

By SYLVAN HARRIS

Editor-Manager of the Society of Motion Picture Engineers

In the article which follows Mr. Harris gives us a brief account of recent developments in the field of 16 mm. pictures, particularly with relation to the activities of the Society of Motion Picture Engineers and its efforts to promote a system of standards beneficial to that Industry. Mr. Harris is an interesting and informative writer and is intimately associated with the work which he describes.—THE EDITOR.

THE attention that is being given to the various problems involved in designing and manufacturing equipment for projecting sound pictures from sixteen millimeter film apparently presages the important part that this branch will play in assisting to rehabilitate the entire industry. The inception of this new branch of the industry, taking place during such a period of economic stress as we are now experiencing, is remarkable in that very respect that it will provide a tonic that will act toward relieving to some extent the general weakness that now reduces our economic activity.

There is no doubt that symptomatic evidences of disease often appear more important than they should and those which display pronounced superficial effects generally cause more distress than those that lack these aspects but which are inherently more dangerous.

Progress Being Made

Without discounting, therefore, the true seriousness of the economic condition that now exists, it appears that the outward evidences of depression are certainly not sufficient to warrant our losing confidence in the outcome. And furthermore, the very fact that the industrial plant is sprouting new shoots is evidence that fundamentally the organism is still in a healthy condition and is capable of growth.

It is growing even now, although its growth may not be noticeable, because the vitality that it manifested a few years ago in certain directions is now being manifested in other directions. The apparent partial discontinuance of growth in the older and well-known directions is all that is at first apparent; the diversion of this growth toward new and unknown directions, toward the sprouting of new shoots, is less noticeable, and progresses more slowly.

The appearance of the new branch of the motion picture art devoted to the sixteen millimeter picture is, perhaps, the first concrete evidence of continued growth in that art. There have been other evidences such as the economic changes that have occurred in the various producing and manufacturing companies; but these are merely current adaptations to changing conditions. Tomorrow they may change again.

Contribution of the S. M. P. E.

Whatever can be done to assist the growing branch of the industry—whoever can assist it—will obviously aid materially toward accelerating the return of what we know as prosperity. The Society of Motion Picture Engineers, realizing this, is consciously making every effort to assist in the successful launching of the new branch of the art. The trends of the art are anticipated in the study that is now being made. This is leading, quickly and surely, to the standardization of the processes involved, and the equipment to be manufactured, for producing and projecting sixteen millimeter sound pictures. By so anticipating the path of progress, and lining it with appropriate signposts, those actively engaged in this branch of the art will proceed concertedly toward a successful goal.

Even so, it is difficult to predict accurately what path of progress will ultimately be followed. There is no doubt that at the beginning the direction traveled will be more or less uncertain. The line will waver slightly, first in one direction, then in another, until finally the best path to travel will be recognized, and ground will be covered more easily and quickly.

Committee Recommendations

For this reason, the Standards Committee of the Society of Motion Picture Engineers, although recommending for adoption as a standard of dimensions for sixteen millimeter film a lay-out embodying only a single row of perforations, has also provided, as a non-recommended standard to be followed if the trend of the art so indicates, an alternative lay-out embodying two rows of perforations.

By so doing, even though two lines of endeavor may have been established, which may lead to a division of effort, these lines are well defined and clearly specified. This means that in the future, if those who followed one line should wish to turn to the other, they may do so without fear of having to travel an entirely unknown path or blaze a new trail unassisted by the knowledge and experience of others. And further, the establishment of the two paths probably precludes the necessity of any one's being required to turn to a third, with resulting serious confusion to the industry.

That the market for sixteen millimeter equipment already exists is evident. That the manufacturers of such equipment are aware of the existence of the market and are desirous of supplying it with equipment is also evident. But that the price at which the equipment and film can be furnished to the market can be reduced to such a value that equipment will be sold in such quantities as to permit taking advantage of the economies afforded by producing in large quantities is not so clear.

Standardization Imperative

It is important, therefore, for the economic welfare of the motion picture industry (and this applies, as well, to all industries) that the standardization of the product be effected as quickly as possible. Films should be standardized to conform to the projectors. Cameras should be standardized to conform to both of these. Methods of processing film should be standardized, and uniform densities obtained so that acceptable pictures can be projected from any film by any projecting machine. In short, the conditions must be such that equipment and film may be interchanged, replaced, repaired, and installed, with the utmost ease and economy, thus making it practicable and convenient for a large number of persons to purchase and use sixteen millimeter equipment and making it possible to employ mass methods of production and market the equipment at a price within the means of the great number of prospective purchasers.

These are the problems now confronting the various committees of the Society of Motion Picture Engineers. The Standards Committee, as stated before, is working vigorously to establish dimensional standards for the films, and expects to release its findings to the industry about the time of the spring convention of the Society at Washington, D. C., May 9 to 12. The Papers Committee is collecting, for presentation at the convention, discussions of the various problems involved in producing and projecting sixteen millimeter sound pictures by those who are intimately engaged and interested in the work. The Projection Screens Committee is studying the various screen problems that will of necessity arise before long, and it is probable that sooner or later the Color Committee may have to take up the problems of applying color to sixteen millimeter pictures.

Use and Care of Motion Picture Film

By H. L. KOOSER and CHARLES ROACH

The subject of the Use and Care of Motion Picture Film is one of paramount importance to every projectionist. In the treatise which follows, the authors note some of the common troubles experienced with film and offer suggestions for correction and prevention of them. No claim is advanced that the information which is supplied is revolutionary or startling in its character, but the article contains much that cannot fail to be of assistance to the discriminating reader. Mr. Kooser is a member of the staff of the Visual Instruction Service of the Iowa State College, Ames, Iowa, and the material is published through the courtesy of that institution. Mr. Roach was formerly Director of Visual Education, Los Angeles Public Schools.—THE EDITOR.

THERE are today two general types of motion picture films in use, the nitrate of cellulose or inflammable stock and the acetate of cellulose or non-inflammable stock, more familiarly known, perhaps, as "safety" film. "Safety" film is so indicated by the word "safety" which is printed at intervals along the outer margin of the film.

The inflammable stock is used almost entirely in theatres while the "safety" stock is coming to be used more and more for educational purposes.

Theatres are better able to cope with the fire hazard, and inasmuch as "safety" film is much more subject to deterioration than the inflammable stock, they do not use "safety" material extensively.

The National Board of Fire Underwriters specify that all projectors must be enclosed in standard fireproof booths when using inflammable stock. Certain portable projectors are authorized for use by non-professional operators and with slow-burning or non-inflammable stock, standard width, without booths. Local ordinances and electrical codes should be consulted at all times.

Standard width motion picture film is 1⅜ inches in width with 5.4 perforations per inch of length. All film used in commercial work is standard width.

The average reel of standard width motion picture film contains about 1,000 feet upon which are printed 16 separate and distinct pictures per foot. Each reel is a photographic reproduction of a series of snapshots printed from a master film or negative.

Films are very fragile, easily injured and a single wrong adjustment of a projector will do irreparable damage to them. The greatest sources of trouble arise from the sprocket hole perforations and poorly made splices—sometimes called patches. During projection the film moves in front of the light at the average rate of 90 feet per minute with 16 distinct stops and starts per foot. One-sixth of the time the film is in motion and during the remainder of the time the film is motionless at the aperture.

Film Deterioration

At normal speed each successive picture moves into position before the aperture in approximately 1/100 of a second. It can be readily understood that there is considerable strain on the film, particularly at the sprocket hole perforations along both edges of the film. The following contribute to rapid film deterioration and subsequent projection difficulties: Dirt accumulations, worn sprocket teeth, too strong tension, poorly adjusted idlers, misalignments of working parts, surplus of oil and grit, accumulations of loose emulsion and wax, and careless rewinding, packing, shipping and storing.

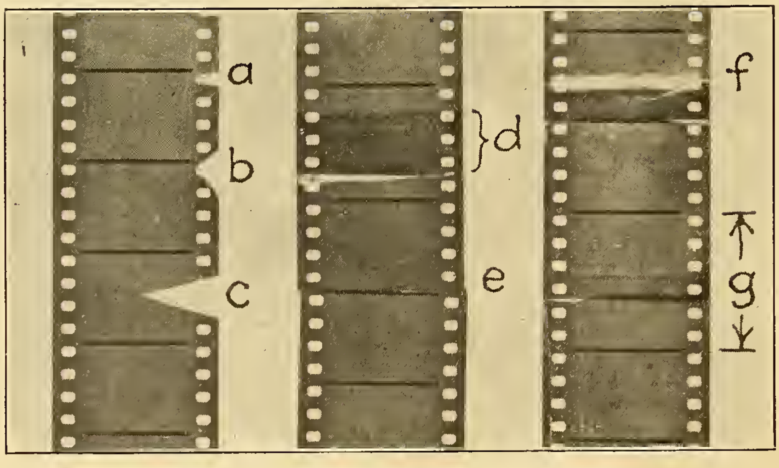


Fig. 1. Proper and Improper Film Repairs

Film usually comes from the exchange properly wound and apparently ready for the projector. However, it is never advisable to project film without first inspecting it while rewinding from one reel to another. Even though the exchange may employ inspectors who are capable, there are times when in the rush to make shipments, the inspection is carelessly done. Loose patches, misframes, broken sprocket holes and small tears may have escaped attention.

Every user of film should be provided with a bench film rewind supplied with a brake. The bench rewind, as the name indicates, should be fastened to a table, shelf or bench. A hole about 4 x 4 inches should be cut in the bench and fitted with a piece of ground glass. Beneath the ground glass may be placed a 5- or 10-watt electric lamp. A film mender should be permanently fastened adjacent to the ground glass on the bench or table. A bottle of the best grade of film cement (not glue or library paste), a safety razor blade or film scraper, and a small pair of scissors complete the necessary equipment.

For inspection, the reels should be placed on the rewind attached to a table so that the film, while being rewound, travels from left to right, with the emulsion or dull side up. The film should be held between the left forefinger and thumb with just enough pressure to keep good contact with both sides of film.

Rewinding and Inspection

If rewound *very* slowly it is possible to detect every broken sprocket hole, tear, defective patch or misframe. Especial care must be exercised not to overspeed the rewinding process, lest the rough sides of an imperfect, bent or distorted reel may injure the film. It is impossible to detect imperfections when the film is traveling rapidly.

If the film is guided into the reel properly the edges of the successive turns of the film will build a perfectly flat disc-like surface. A thousand-foot reel should never be rewound in less than five minutes—a longer time is recommended. As much damage may be done during one careless rewinding operation as would be done during many trips through a projector. *The temptation to hurry has ruined thousands of feet of film.*

During the rewinding and inspecting operations it is always advisable to have a brake attached on the part of the rewind holding the film being rewound, so that a slight tension may be kept on the film. This is especially necessary for any reel that contains a thousand feet or more. If loosely

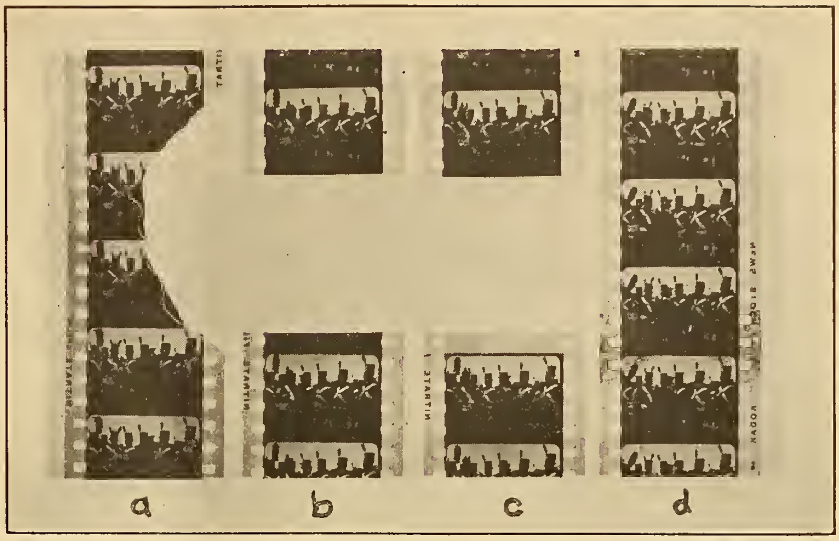


Fig. 2. Various Stages of Making a Splice

rewound, the reel will be more than filled. There is then a temptation to "pull down" the film, causing it to tighten on the reel with a crunching sound. "Rain streaks" or scratches running longitudinally on the film are many times caused by "pulling down." When the streaks once appear they cannot be permanently removed. *The careful projectionist never "pulls down" film. He rewinds it a second time if necessary.*

Making Repairs

If the film breaks in the projector, the two pieces may be temporarily fastened by means of wire paper clips. The use of common pins is extremely dangerous, especially for the inspector, who, when he rewinds the film, unaware of the pin, may suffer a severe and painful injury from it. Infections, as a result, are not uncommon, and subsequent amputation of finger, thumb or hand may be necessary. No considerate operator will deliberately return a film fastened by a pin to an exchange, or send it to a fellow exhibitor on circuit in that condition.

When possible, repairs should be made as soon as the necessity for them is detected. The most numerous film defects are broken or torn sprocket hole perforations. The repair is made by cutting the V-shaped notches as is illustrated in Fig. 1. Please note (b) in Fig. 1. The corners of the V-shaped notch have been carefully rounded.

Never cut into the picture (or into the sound track) as in (c). Should it be necessary to remove several damaged sprocket holes, it is suggested that a splice be made where more than three holes are missing. Never make removals of two or more holes on sides of the film directly across from each other. If the broken portions of the film are not repaired they may catch on the idlers, wind around sprockets and cause the loss of a loop or break.

Splicing the Film

The least possible number of frames should be removed. One end of the film should be cut on the frame line immediately between two of the sprocket holes. The other end of the film should be cut so that it extends to within about 1/8 or 3/16 inch beyond the frame line. Thus the second cut will be between the first and second sprocket holes beyond the frame line. (Fig. 2.)

All of the emulsion should be scraped from the second portion of the film, that beyond the frame line. A razor blade may be used for this very satisfactorily. (Fig. 3.) The film from which the emulsion is to be removed should be placed upon the illuminated piece of ground glass, emulsion side up. In this way the frame lines may be easily detected.

Some operators moisten the part from which the emulsion is to be removed, but this is not necessary. All moisture should be wiped off before the cement is applied.

The important thing is to remove all of the emulsion up to the frame line and at the same time avoid removing any of the emulsion from any portion of the next frame. Do not scrape the film more than is necessary for the complete removal of the emulsion. If the celluloid base is scraped to any extent, the possibilities of a good splice are decreased. When this base is thin, the cement oftentimes dissolves it and makes it pliable and quite useless as far as a necessary part of a good splice is concerned. Always remember that if the emulsion is removed carelessly, a firm splice is an impossibility.

It is also very important to be sure that when the splice is completed, the regular sequence of pictures is complete, that is, the distance between each frame line should include four complete sprocket holes. If this rule is not followed, when the picture is projected, there will be a time when part of one picture and part of another will appear on the screen. When this occurs there is in the film what is commonly termed a misframe.

Matching Sprocket Holes

The next operation is equally important, although it is frequently done carelessly. It should be remembered that every slight variation at the aperture is multiplied many fold on the screen. It is commonly observed on many screens that the picture jumps vertically, at regular intervals. There are many causes, but among the many, none is more prevalent than imperfectly made splices. Perhaps the sprocket holes do not match. It is absolutely necessary that sprocket holes match perfectly if a proper splice is to be made. The following procedure is recommended:

After the emulsion has been properly removed from the one end of the film be sure that the celluloid side of the other is clean so that the cement will have free access to the film. The two ends should be placed in a film mender, being sure that the frame lines are exactly superimposed. The operator should see to it that the sprocket holes exactly coincide and the edges of the film are in perfect alignment before the cement is applied.

Film cement is a solvent and dissolves the film, but it is so composed that the active agent evaporates very rapidly. The union of two pieces of film is a cohesion process and resembles a weld, rather than an adhesion. Glue or library paste cannot be used for mending film. Slightly dried cement loses those properties that make the film cohere. When making splices it is necessary to work very rapidly. A few drops of glacial acetic acid added to the cement will help in making splices. Always keep the film cement bottle tightly corked.

Time Required

The time between the moment the cement is applied and pressure is applied should be brief. The operation can be accomplished quickly by having first perfectly superimposed the holes and frame lines and properly aligned the film edges in the mending device. One end of the film should then be lifted by the left thumb and forefinger and a very thin coating of film cement applied to the other piece. (Fig. 4.) The part held by the thumb and finger should be released instantly, the surplus cement removed by passing a finger across the splice, and the pressure clamp on the film mender set firmly for a few seconds. The application of cement and the application and removal of pressure should not require more than five or six seconds. Too much cement will result in a hard, inflexible splice. All surplus cement should be removed from the sprocket holes.

If the splice is made wider than

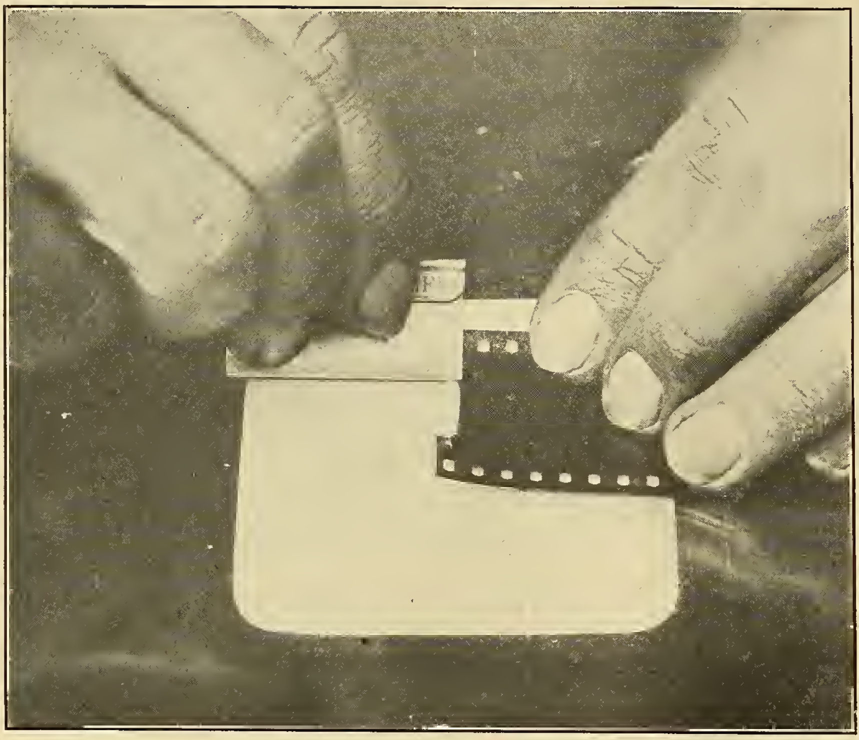


Fig. 3. *Removing Emulsion With a Razor Blade*

1/8 or 3/16 inch there is a tendency for it to dry out and buckle slightly. If the splice is very wide it will cause trouble when the film passes through the projector.

Be sure that the splice is securely cemented before continuing the inspection. This is very, very important.

Splicing "Safety" Stock

"Safety" or non-inflammable stock has certain properties that tend to make it, in many cases, somewhat difficult to splice. The two parts of the film should be prepared in exactly the same way as indicated above. However, in this case, it will aid materially if the celluloid side of the film that is to be used in the splice could be abraded or scraped slightly.

When splicing this type of film use cement that has been prepared for both inflammable and non-inflammable film. Another aid is to add a very small amount of glacial acetic acid to the bottle of cement. A few drops added to a small bottle of cement will suffice. When splicing "safety" film it is necessary to work very quickly. *Remember not to use too much cement.*

If for any reason a surplus of oil accumulates on the projector it is quite likely that some will fall on the film, and tend to hold any dust or dirt that may come in contact with it. This oil and dirt may deposit around sprockets, in the idlers, in the film track, and at the aperture opening, and may interfere with perfect projection or damage the film itself.

There are several simple film cleaners on the market that may be bought at small cost. In the absence of a film cleaner a soft lintless cloth held in contact with both surfaces of the film will serve very acceptably. It is quite important to use clean cloths frequently as old ones become soiled. If soiled cloths are used there is a likelihood that rain streaks will be produced. A stiff-bristled tooth brush may be used to remove dirt from the parts of the projector.

New film is said to be "green." In order that it will pass through the projector satisfactorily, the film must be waxed along the sprocket holes on the emulsion side of the film. When a new film is projected, if it is not waxed, an accumulation gathers on the tension shoes immediately in front of the aperture and on the other surfaces. This substance becomes very hard and difficult to remove.

It may be removed by using alcohol as a solvent, or scraping the accumulation away with a coin. Never use a knife because steel will scratch the surfaces. Dirt deposits, scratches and dirt all tend to injure the film. The photographic quality may not be injured, but the film surrounding the sprocket holes may be scratched quite badly.

Keeping a projector clean is an important task of the projectionist.

Tension on Film

Many films have been injured by too strong tension on the take-up reel. Some projectors are designed so that the belt driving the take-up runs just tightly enough to turn the reel. Such devices require frequent adjustments lest for any reason the belt becomes too loose or too tight. Other machines are provided with devices which enable the tension to be regulated by a small screw adjustment. In either case if the tension is too loose the reel may fail to turn when it becomes nearly filled.

If the tension is too tight there may be numerous breaks while the first few hundred feet are being projected. Loss of the lower loop may occur. Great damage may be caused to the sprocket holes themselves. The small radial lines that extend from the four corners of the sprocket holes, as shown in Fig. 5, are evidences of too great tension.

Film may pass through the projector without the notice of any difficulty, even though the tension is too strong, but if the film is closely examined afterwards the damage can easily be detected. After the damage has been done, nothing can undo it. The life of the film is greatly shortened and possibly the very next time it is projected will complete its destruction. No film is better than its sprocket holes. The operator can, by care, keep them in good shape if he will but do so.

The tension shoes may never require adjustment, although they should always be kept free from accumulations at all times. If the tension is unusually strong at the tension shoes it will cause a drag on the film that will not only injure the holes but will cause unusual wear on the intermittent movement and on the intermittent sprocket teeth.

At the very first sign of wear or undercutting on the sprocket teeth a new sprocket should be placed in the machine.

Films are frequently injured during the time they are being threaded into the projector. In his hurry to change reels, the operator may not exercise sufficient care to see that the sprocket hole perforations properly mesh with the sprocket teeth. When the idlers are pushed into position the fragile film edges are broken or torn. This is one reason why the first few feet of many films are in poor condition.

Watch the tension of the projector carefully. It is very important.

Receipt, Storage and Shipment

Immediately on receipt of the film program it is always desirable to rewind the program, inspect the films, and, if necessary, clean them. The exchange tries at all times to keep the films in the best possible condition, but occasionally a reel will "slip through the hands" of an inspector who may be a bit careless.

Film should always be kept in metal containers when not in the projector or in the process of inspection.

All film will dry out and become brittle if exposed to the air for long periods. "Safety" or non-inflammable stock dries out very quickly.

If the film is dry and brittle it may be made much more pliable by winding loosely and placing it in a humid atmosphere. A basement, far removed from fire or furnace, a cellar or cave, make excellent storage rooms. Sometimes a few blotters containing moisture placed in the metal film box will prove advantageous. Oftentimes oil of eucalyptus is used in this same way. A few drops on blotters in the bottom of a shipping case will serve very well.

Humidor cans are for sale by dealers. A solution of eucalyptus oil, camphor, menthol and glycerine is reputed to soften even the most brittle and least pliable film. Extreme care must be exercised in any case so that the moisture does not come in direct contact with the emulsion. When films lose their original pliability it is difficult to bring that quality back, permanently, by any artificial means. For that reason film should be kept in a humid atmosphere at all times or inside tightly closed metal containers.

No film should be left exposed at any time. The small pieces which accumulate during repair operations should never be permitted to remain on the bench or on the floor. They should be deposited in a tight metal box and removed to some safe place outside of the building where they may be destroyed.

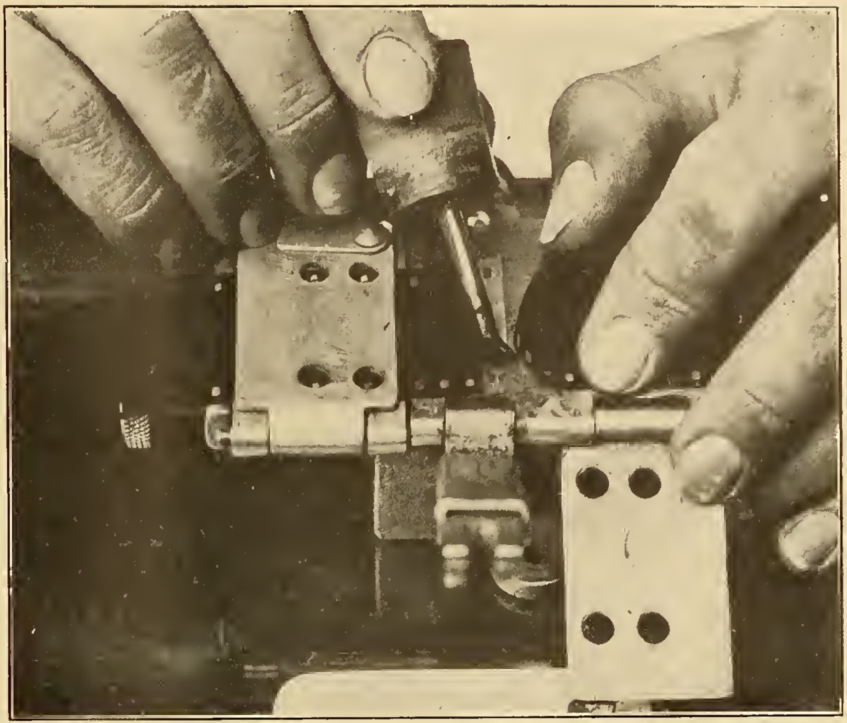


Fig. 4. Method of Applying Film Cement

Precautions in Handling

If handled with the same precautions as are necessary for safe handling of gasoline, kerosene, oil, ether, celluloid toilet articles or even the rolls of film used in a camera or Kodak, the danger involved with motion picture film is small. A bucket full of sand, wet sawdust, a chemical fire extinguisher or even a wet woolen blanket should be kept handy to be used in case of an emergency.

Following the exhibition, film should be replaced on exchange reels, the film retained by securely fastened reel bands, and each reel immediately placed in the metal film container. It is commonly observed that the first and last twenty-five feet of film are in poorest physical condition, due partially, at least, to the improper manner in which reel bands are attached by indifferent operators. The reel bands come off, the loose ends unwind from the reels and become jostled during transit.

The exchanges prefer to have film reach them just as the reels come out of the projector, and reel bands usually bear the words "Do not rewind after showing." This request is made to save time at the exchanges.

When films are on circuit the operator should repair all breaks and make all patches before he ships the program to the next destination. This is particularly necessary because film on circuit reach the film exchanges at more or less irregular intervals. If the repairs are left to accumulate, by the time the program reaches the last town on circuit the film may be in unusable condition. The circuit plan of distribution is very satisfactory if each member on the circuit has the proper "circuit conscience." A greater number of exhibitions can be scheduled for a given period, transportation charges reduced more than half and the overhead reduced materially. The operators using circuit programs are naturally expected to give every reel careful attention.

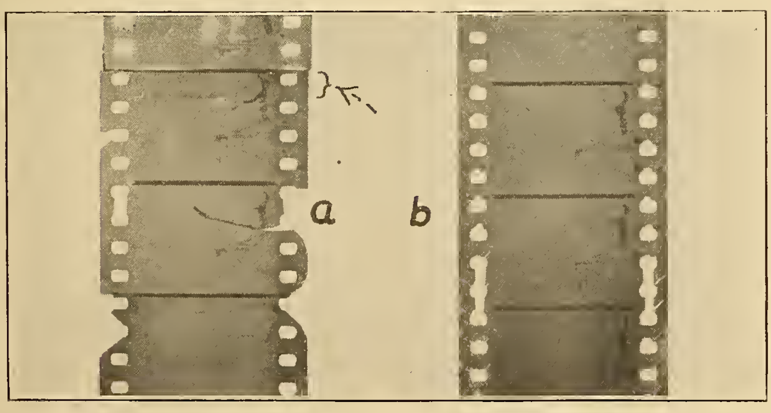


Fig. 5. Poor Splice and What Happened

All former addresses, labels, tags and stamps should be removed from the outside of the film case before the shipment is sent on.

Each case must carry a new yellow caution label bearing the name of the shipper. Labels on express shipments must also carry the date when the shipment was made. The case must bear the words "Motion Picture Film."

Methods of Shipment

As a general rule, within the first and second zones, parcel post rates are less than express.

Postal regulations do not permit written material to be enclosed with a package shipped by parcel post. Messages should be placed in an envelope bearing a two-cent stamp. This stamped envelope may be attached to the shipping case. The express company permits writing to be placed in any container without extra charge.

Exchanges require the exhibitors to pay both incoming as well as outgoing transportation charges. Express or postal receipts should always be preserved for future reference, should any occasion demand their presentation. The consignor may recover damages only upon surrender of these receipts.

The shipping label should indicate the name of the consignor as well as the consignee. Library paste is not recommended for affixing labels. Use a good glue for this. Shippers should fasten tags on the container by heavy cord or wire.

The express company guarantees safe arrival of a package, and insurance against loss up to $50.00.

The Problem of Non-Intermittent Projection[*]

By FORDYCE TUTTLE and CHARLES D. REID[†]

The treatise is carried forward with a continuation of the discussion on the various types of continuous or non-intermittent projectors. Classification of types is made according to the optical means of forming the fixed image. The first installment of the series appeared in the March issue of this publication.—THE EDITOR.

Part II.

THE problem of moving cylindrical lenses in such a manner that the image will appear stationary is not as difficult as is the problem of moving spherical lenses, since we do not have to worry about any horizontal displacement of the lens element in moving down across the gate. The difficulty of using cylindrical lenses is an optical one. It is necessary to assume that crossed cylindrical components, one moving, one stationary can be designed to behave like a well-corrected spherical lens.

The Refracting Prism

The refracting prism stationary in the beam produces defects in the image, giving errors of the first type. The problem of changing the refracting angle of the prism in a satisfactory manner is difficult and in some cases produces errors of the second class.

If the prism is used in the beam on the long optical side, as shown in Fig. 9, or even in collimated light, we produce distortion in the image. If the motion picture frame to be projected is entirely above the optical axis of the lens and if we use a prism strong enough so that the light from the center point of the picture passing through at minimum deviation will be deviated so as to fall on the center of the screen, light from the top of the frame will pass through the prism at some angle differing from minimum deviation and will be bent more than it should be. Light from the bottom of the frame will also be bent more than it should be. This will cause a lengthening of the top part of the image and a shortening of the bottom part of the image. If the prism is used on the short optical side of the lens, as shown in Fig. 10, light from a point on the film going to various parts of the lens will be deviated varying amounts, and the point will be imaged on the screen as a line of considerable length.

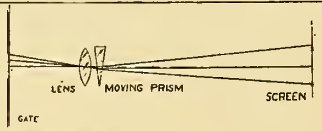


FIG. 9 *The distortion produced by a prism on the long optical side of the projection lens.*

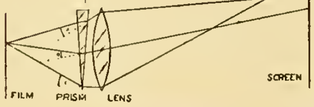


FIG. 10. *The astigmatic effect caused by a prism on the short optical side of the projection lens.*

Fig. 11 shows the departure in the angle of deviation from minimum deviation for rays passing through prisms at various incident angles. That these departures are serious is shown from a consideration of the fact that a departure of one minute in angle with a 2″ lens would produce a displacement in the center part of the picture equivalent to .001″ on the film frame if the prism is assumed to be close to the lens or on the long optical side. If the frame subtends an angle of 10 degrees at the lens, a 10 degree prism is necessary to shift the image one-half frame on the screen.

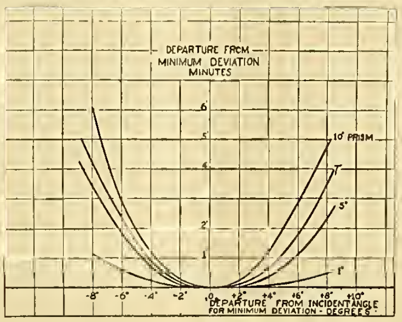


FIG. 11. *The departure from minimum deviation produced by changing incident angle.*

If we consider the center part of the picture at all times passing through the prism at minimum deviation, rays from the top of the picture will be incident on the prism, at angles differing from the incident angle for minimum deviation by 5 degrees. This would be serious. However, it may be perfectly feasible to use a refracting prism on the long optical side if the film frame subtends a small angle at the lens or on the short optical side if the lens subtends a small angle at the film frame.

Correction for Deviation

Fig. 12 shows a method by means of which we might partially correct for deviation troubles. By using two prisms so tilted with respect to each other that the ray which passes through the first prism at an angle differing greatest from minimum deviation goes through the second prism at minimum deviation and the ray passing through the first prism at minimum deviation passes through the second prism at an angle differing greatest from minimum deviation, the total deviation produced in the two rays considered will be practically equal.

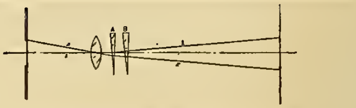


FIG. 12. *A suggestion to eliminate the distortion caused by the variation of deviation of a prism with incident angle*

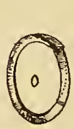


FIG. 13. *A method of continuously changing the angle of deviation of a prism to produce optical compensation.*

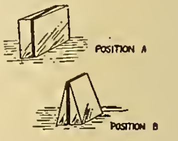


FIG. 14. *A second method of continuously changing the angle of deviation of a (compound) prism.*

As the film frame moves down over the gate, it is necessary to change the refracting angle of the prism to keep the center point of the image stationary. This changing of the angle of the prism is an awkward problem. Two methods are fairly feasible. The first is shown in Fig. 13 and consists of an annular disc which is ground so that the refracting angle gradually changes from a prism with its thick side towards the center of the disc to a plane parallel plate and then to a prism with its thick side towards the circumference of the disc.

Two Methods and Effect

The use of this warped refracting element in a projector introduces a skew distortion in the picture in addition to the distortions already discussed for the fixed prism. These new distortions become small if the prism disc is very large. The use of two warped refracting elements may allow cancellation of the skew distortion. Such an element is very difficult to make. Of course, it would be very difficult to achromatize it. It might be argued that it is not necessary to achromatize prismatic elements which appear in rapid succession first base side up and then base side down in the beam because persistence of vision would make superimposed complementary colored fringes appear nearly colorless. The trouble with this argument, however, is that the limit of definition of a horizontal line becomes the width of the spectral image of that line.

Another method of changing the refracting angle of prism elements is shown in Fig. 14. Two equal prisms placed with their emergent and entrance faces together may form a compound prism that will act as a plane parallel plate if the thick side of one is placed opposite the thin side of the other, as shown in position *A*.

Now, if these prisms are each rotated through 90 degrees in opposite directions, we may arrive to the position B which gives us a compound prism twice the power of its component prisms. It will be noted that any horizontal displacement produced by one prism is offset by an equal but oppositely directed horizontal displacement produced by its companion prism. The vertical refracting angle, however, varies sinusoidally from zero to twice the refracting angle of the single prism. When prisms of this type are used in a non-intermittent projector, it is necessary to reciprocate them angularly with some cam motion and to have a shutter to cover the return.

---

[*] Journal, Optical Society of America.

[†] Development Department, Eastman Kodak Co., Rochester, N. Y.

Plane Parallel Plate

The mere presence of a tilting plane parallel plate used in the beam of light produces defects in the image, while the method of tilting it also presents some difficulties.

The plane parallel plate used in a non-intermittent projector will have to be used on the short optical side of the projector system, or else be tremendously thick, since the displacement produced by the plate is a parallel one rather than an angular one. On the film side of the lens a parallel displacement of a fraction of an inch will compensate for the full movement of the film and shift the screen image several feet.

Fig. 15 shows the displacement produced by a plane parallel plate, and Fig. 16 shows the variation of this displacement with the angle of tilt of the plate for a one-inch and a half-inch plate. It will be observed that the relation is not a linear one, and hence the proper movement of the plates constitutes a problem unless the motion is to be controlled by a cam surface. The use of a plane parallel plate normal to the axis introduces spherical aberration and astigmatism. Fig. 17 shows how a point on the axis of the lens is imaged as a circle of considerable diameter on the screen. Fig. 18 shows the direction of rays from a point off the axis of the lens if the rays pass through a tilted plane parallel plate on the short optical side of the lens. The apparent definition on the film is affected, then, by the use of the plate and the position of the plate.

If a 2-inch $f/2$ lens is used with a plate one-half inch thick, all of the rays which reach the screen from points on the film can be accounted for only if we imagine the points on the film extended to a considerable size. The plane parallel plate, in other words, is producing virtual images of the points and makes them appear to the lens as discs or streaks. Fig. 19 shows the major axis of the confusion discs for different points on the film and for different angular positions of a one-half inch plate.

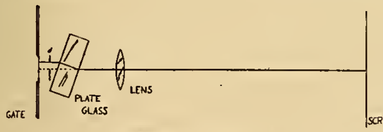


FIG. 15. *The type of displacement produced by a plane parallel plate.*

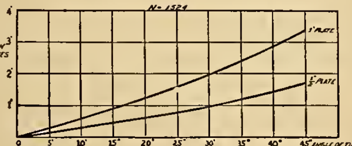


FIG. 16. *The relation between the displacement produced by a plane parallel plate and the angle of tilt of the plate.*

It will be noted that when the plate is tilted, the position of best apparent definition on the film shifts. It is, of course, impossible to correct the lens by any stationary means for this varying astigmatic effect. The use of a similar moving plate on the image side of a one-to-one system might seem at first to offer a chance for correcting the defect; but unfortunately both spherical aberration and astigmatism in such a system are additive. Probably the best the optical designer can do is to correct the system for spherical aberration when the plate is normal.

It may be advantageous to use a long focal length lens when a tilting plate is used. With a long focal length lens the definition is more uniform over the area considered because the film frame subtends a much smaller angle at the lens. It is not always advantageous to do this, however. The dotted curve shown in Fig. 19 shows the major axis of confusion discs for a 10″ $f/2$ lens when a one-half inch plate is tilted at 10 degrees. Comparison of the definition obtained in this manner with that obtained with a one-half inch plate tilted at 10 degrees with the 2″ $f/2$ lens shows that we do not gain in definition until we get some distance below the axis or considerably above the axis.

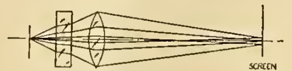


FIG. 17. *The circle of confusion on the screen produced by the spherical aberration of a plane parallel plate on the short optical side of the projection lens.*

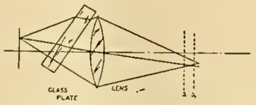


FIG. 18. *Blurred image on the screen produced by a tilted plane parallel plate on the short optical side of the projection lens.*

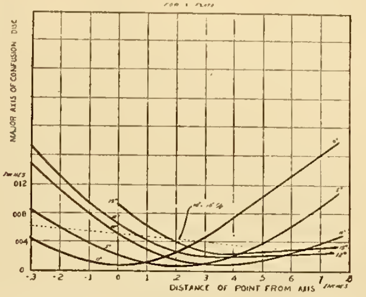


FIG. 19. *The magnitude of the major axis of confusion disc caused by a one-half inch plane parallel glass plate in conjunction with a 2″ f/2 projection lens as a function of the distance of the object point off the axis for different tilts of the plate. The dotted curve refers to a 10″ f/2 lens with the plate tilted at 10 degrees.*

(*To be continued*)

RCA Victor Announces New Photophone Sales Policy

With an announcement covering the introduction of two new all AC-operated equipments, which have been designed for theatres up to 4,000 seating capacity, a substantial reduction in the prices of three types of apparatus, a further reduction in service charges and an entirely new merchandising policy, E. O. Heyl, manager of the Photophone Division of the RCA Victor Company, created something of a sensation at the conventions of the Allied Exhibitors in Detroit and the Motion Picture Theatre Owners in Washington. In making his unexpected announcement, which was received with unanimous acclaim by the assembled exhibitors, Mr. Heyl said he was transmitting to them the first fruits of the economies resulting from the recent consolidation of RCA Photophone with the RCA Victor Company and that he hoped that exhibitors all over the country would recognize its importance.

The two new all AC-operated sound-reproducing units, which Mr. Heyl referred to as the Standard Large, for theatres having from 1,400 to 2,500 seating capacity, and the Standard Super, for theatres having from 2,500 to 4,000 seating capacity, are the only standard equipments operated by AC power supply that have been designed for theatres of the capacities mentioned. In addition to the convenience provided by the elimination of batteries and motor generators and the resultant saving in upkeep and installation cost, the prices of these two equipments have been reduced. Heretofore, the so-called Super Size Equipment's lease price was $8,000. The price of the new Standard Super, all AC operated, is $5,000. The former price of the Standard Large equipment was $6,000. The price of the new Standard Large, all AC operated, is $3,750.

Mr. Heyl also announced that the seating capacity limitations of the all AC-operated Special Size equipment has been increased to 600 seats; the Standard Small Size to 1,400 seats and the Standard Large Size to 2,500 seats. Service charge reduction from $32.50 to $25.00 a month on the Special Size equipment; from $65.00 to $32.50 on the Standard Small Size equipment and a reduction from $130.00 for four contract calls to $65.00 for two calls monthly on the Standard Super Size equipment and a reduction in the financing interest and collection charges also were announced.

"We want exhibitors in all parts of the country to know that their interests are our interests," said Mr. Heyl. "We have worked long and hard in our efforts to reach the goal we had hoped to attain and it is a pleasure for me to announce their far-reaching results at this meeting."

The Fundamentals of Sound

By LEDWARD EVERETT

The second installment of this informative series of articles on the fundamentals of sound concerns itself mainly with auditory sensitiveness and simple wave formations. Information of this character should be of great value to the projectionist in that a clear understanding of the principles of sound will be conducive to a better appreciation of the difficulties and the problems involved in its recording and reproduction. — THE EDITOR.

Part II.

THE elasticity of the eardrum is more pronounced in youth than it is in old age, the hardening process increasing as a person advances in years. The process is, in fact, not restricted to the eardrum alone, but is evidenced in many other parts of the body which harden and grow less elastic with age. The result of this hardening process is, of course, that the band of audible frequencies narrows and a person cannot hear sounds of as high or as low a pitch as he could when he was younger. This point is illustrated somewhat in the chart (Fig. 5).

Sensitiveness of the Ear

In order for the ear to detect any difference between the volume of one sound as compared with another, it is essential that there exist a definite difference in the pressure which the sound waves exert upon the eardrum. Unless this difference in pressure is great enough, the ear will not be affected to a sufficient degree to enable it to recognize the existence of any difference in the loudness of the sounds.

The amount of difference in pressure required to make the change in loudness appreciable to the human ear varies for the different frequencies. Thus it is, that while it only requires a change of about 3/10 of 1 per cent to permit the ear to differentiate in loudness at frequencies from 500 to 4000 cycles per second, it necessitates many times this difference in pressure at frequencies below 500 cycles per second or above 4000 cycles per second.

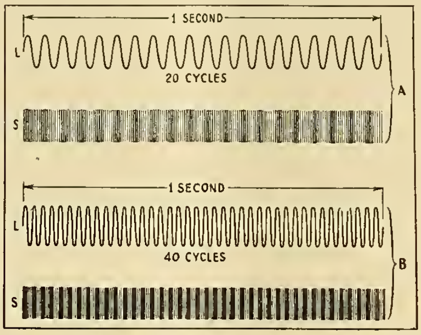


Fig. 6. Wave Properties

As is obvious from reference to the chart in Fig. 5, it requires almost 100,000 times as much pressure for the ear to detect a difference in loudness at 20 cycles per second and 20,000 cycles per second as it does at 2,000 cycles per second. Since the sensitivity of the ear to sound waves is dependent to a certain degree upon the elasticity of the eardrum, it is apparent that as a person advances in years and the eardrum hardens somewhat and thereby becomes less sensitive, the person will first lose the ability to hear the lowest and the highest frequencies and there will be for him a gradual narrowing of the audible band of frequencies.

The progress of increasing deafness because of age may, therefore, be expected to be somewhat as follows: Failure, in the beginning to hear the frequencies at the lower and the upper limits of normal hearing, that is, 20 to 30 cycles and 20,000 to 15,000 cycles. As time goes on the band would gradually narrow down to say from 60 to 6,000 and so on until probably the last frequency such a person would be able to hear would be about 2,000 cycles per second (this latter being the frequency to which the ear is most sensitive).

There are many ways of producing sound, the common characteristic of all of them being that they vibrate or oscillate and thereby set up waves of compression and rarefaction in the air. These waves have properties of both frequency and amplitude as shown in Fig. 6.

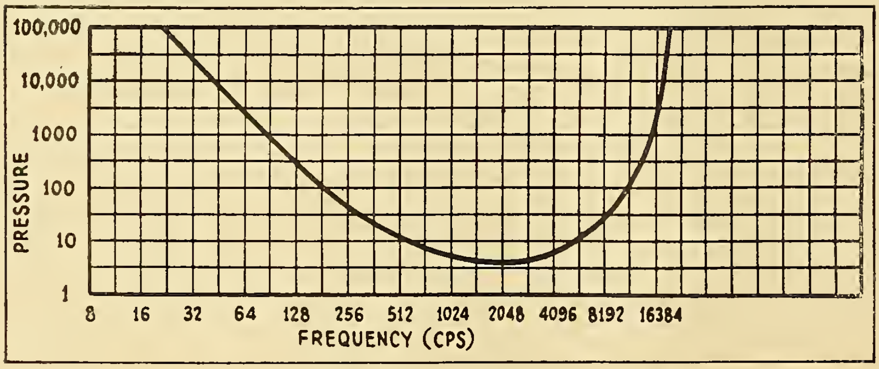


Fig. 5. Pressure vs. Frequency Curve

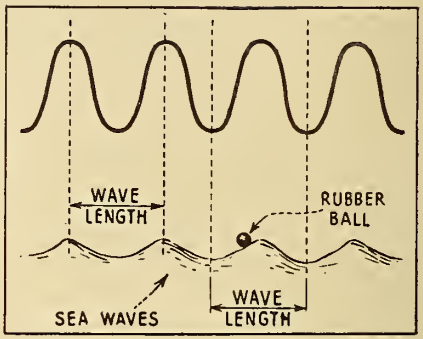


Fig. 7. Principle Visualized

The character of sound waves is said to be longitudinal, that is, they move backward and forward in the same direction in which they are traveling. Referring to Fig. 6A, the dark and the light sections, which are labeled S for sound, represent compressions of the air as it travels horizontally, while the sine wave, labeled L for light, shows a “transverse wave’ which travels at right angles to the direction of its motion. This wave L, although it travels horizontally, has a motion which is vertical.

An attempt has been made in Fig. 7 to visualize this. If a rubber ball were floating on water as shown in the drawing, it would only move up and down vertically as the waves pass under it in their horizontal travel. It is obvious in this drawing that the sine wave as shown above the water graphically illustrates this form of wave motion which is called “transverse” because it is at right angles to the direction of wave spread.

Comparison of Types

Comparing the transverse and longitudinal waves shown in Fig. 6, it is evident that the part of the transverse wave L which is above the line corresponds to the area of compression in the longitudinal wave S, while the part that is below the line corresponds to the rarefied area of the sound wave S.

The length of time, which is shown as one second in Fig. 6, contains in the case of A, 20 complete cycles of both transverse and longitudinal wave motion. In the case of B there are double the number, or 40 complete cycles of each in the same second. It is said, then, that the waves A have a frequency of 20 cycles per second, and those in B have a frequency of forty cycles per second.

The amplitude of the transverse wave L is shown by the distance of the sine waves above and below the line, while in the case of the longi-

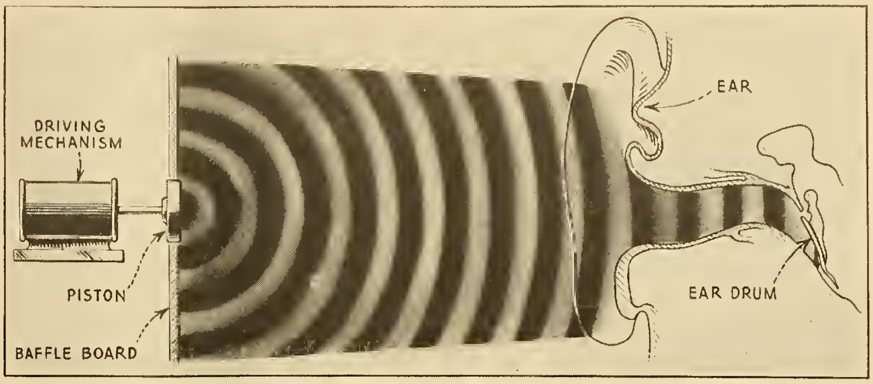


Fig. 8. Sound Wave: From Source to Ear

tudinal or sound wave, the amplitude is indicated by the difference in shade between the light and dark bands. The amplitude or strength in a sound wave depends upon the difference in pressure between the areas of compression and the areas of rarefaction.

Effect on Eardrum

Referring to Fig. 8, we shall demonstrate the manner in which a sound wave, striking upon the eardrum, causes the latter to move in and out the same number of times per second as the frequency of the wave. The sound waves are shown traveling outward from their source, until they are intercepted by the ear and carried inward to the eardrum.

Now, when an area of compression strikes the eardrum, the eardrum moves inward, and when the succeeding area of rarefaction arrives, the eardrum returns to normal and beyond. Therefore, if 500 areas of compression and 500 areas of rarefaction impinge upon the eardrum per second, the eardrum responds by moving inward and outward 500 times per second and by means of the internal action of the ear 500 impulses are sent along the nerves to the brain. The brain interprets these impulses as a sound of five hundred cycles.

A similar action takes place for the various frequencies within the audible range of normal hearing. While the eardrum responds to frequencies below 20, these do not register upon the brain. Regarding the frequencies beyond the upper limit of normal hearing, that is, frequencies above 20,000 cycles per second, the structure of the eardrum and the connecting bones of the inner ear have too much weight and inertia to respond to frequencies above 20,000 cycles per second.

Effect on Microphone

The manner in which sound waves affect the diaphragm of a microphone is analogous to their action on the eardrum. This is apparent by reference to Fig. 9, in which the ear shown in Fig. 8 is replaced by a carbon transmitter.

As in the case of the eardrum, the areas of compression in the sound wave impinge upon the diaphragm and press it inward and the areas of rarefaction cause it to move in the opposite direction or outward. This results in an alternate compression and expansion of the carbon granules G which occupy the space between the two carbon contacts C. The resultant variation in the resistance of the path between the two carbon contacts produces a varying or pulsating current in the line. This current corresponds in frequency to the sound wave.

For producing sounds of certain pitch, the tuning fork is an instrument which is often used. It is bifurcated in form and is made of high quality cast steel. When the prongs are set in vibration, by striking one of them with a soft sharp blow against some object, areas of compression and rarefaction are set up in the surrounding air. These waves travel outward in a similar manner and in fact the entire operation is analogous to the action of the simple sound generator of Fig. 1 (Part I).

The rate at which the fork will vibrate depends upon its size and weight. As we have already stated, each fork is designed to produce a note of definite pitch, and this, as has been explained, will depend upon its frequency of vibration.

A distended or stretched rubber band, when it is plucked with the finger, produces sound waves by compressing the air on its forward motion and forming a rarefied area on its backward motion. It thus constitutes another simple method of producing vibration and sound.

(To be continued)

RCA-Burton Holmes Tie-Up

Burton Holmes Lectures, Inc., the internationally known motion picture lecture bureau and one of the foremost producers of the so-called travelogue type of screen subjects in the world, has contracted for the installation of RCA Victor Photophone recording equipment, according to an announcement by E. A. Nicholas, vice-president and general sales manager of the RCA Victor Company at Camden, N. J.

Under the provisions of the contract entered into between the two companies, Burton Holmes Lectures, Inc., becomes an RCA Victor Company licensee and hereafter will record its sound motion picture product by the Photophone system. For many years the Burton Holmes silent product was released through Paramount. At present and until next September, the current releases of twelve sound picture programs are distributed by the Metro-Goldwyn-Mayer Pictures Corporation.

In addition to maintaining a complete recording studio and laboratories for the production of Standard Size 35 millimeter sound motion pictures at its headquarters in Chicago, Burton Holmes Lectures, Inc., immediately will begin the production of 16 millimeter sound pictures for non-theatrical exhibition through the medium of the recently introduced RCA Victor Photophone portable sound-on-film reproducing equipment. Having upwards of 7,000,000 feet of Standard Size 35 millimeter negative in its vaults, among which are more than 2,000,000 feet that have never been publicly distributed, a vast library of subjects of inestimable value to schools, churches and other non-theatrical institutions is made available. From both historical and geographical points of view, the Burton Holmes library is said to be the most complete collection of its kind in the world. Thousands of feet of exclusive material have been filmed during the past year and a large staff of cameramen, located in various parts of the world, are constantly shipping new subjects to Chicago.

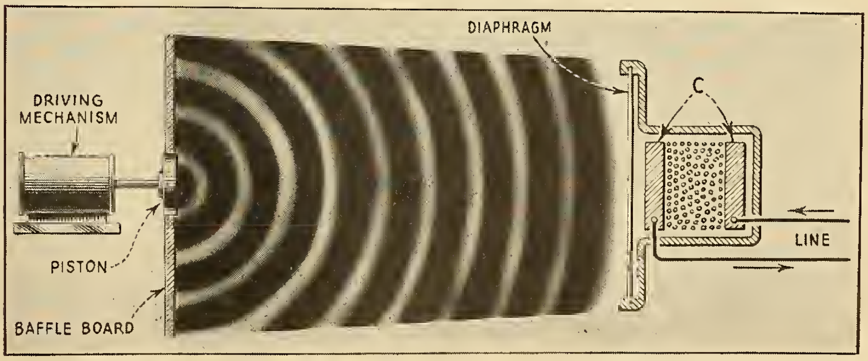


Fig. 9. Sound Wave: From Source to Microphone

Vertical Sound Records

Further Discussion on the Subject

The following is a verbatim report of the discussion which took place succeeding Mr. Halsey Frederick's representation of his recent lecture on Vertical Sound Records. The lecture, which was delivered under the auspices of the New York Section of the S.M.P.E., was published in last month's issue of this magazine. The discussion is of great importance and interest in that it affords a knowledge of the immediate reaction of some of the best minds in the technical branches of the industry to this latest development in the field of sound reproduction.—THE EDITOR.

MR. RICHARDSON: One of the worst things we have to contend with in reproduction and projection of sound is dust, both in records and in the film itself. It will adhere to the film, particularly when a little oil has gotten on the film and will set up heavy ground noise.

It would seem to me that a record of hills and dales would be much more easily injured; it would be more difficult for the projectionist to keep it clear of dust and abrasive materials than a lateral record.

It also seems to me that a sapphire or a diamond point needle running over dust, which unquestionably will collect in the grooves, would have a more injurious effect and set up a greater amount of ground noise than would be the case with the lateral record groove.

Finally, I should like to know what are the limits of range of frequency in conversation and in music.

MR. FREDERICK: As to the effect of dust, our experience with these records has not indicated any particular difficulty. We have taken no particular precautions to avoid trouble. Except where we wanted to play a record thousands and thousands of times, continuously, we have found it necessary to take no special precautions whatever.

As to the limits of speech or music, opinions may differ as to that. If anyone will provide an adequate or an accurate audiogram showing what the upper and lower frequency limits are for his own ear, that will provide the answer to the question. If he is very young and can hear from twenty cycles to seventeen thousand cycles, twenty and seventeen thousand are the limits of his speech and music. If his hearing isn't quite so good and he can hear only from twenty to three thousand, why, that is the limit for him.

(At Mr. Crabtree's request, Mr. Frederick repeated a record, using only the speakers which reproduced the high frequencies.)

Mr. Crabtree Offers Congratulations

MR. CRABTREE: Mr. Chairman, I hasten to congratulate Mr. Frederick and his collaborators at the Bell Laboratories on this epoch-making development. The demonstration this evening, especially of the organ, shows how inadequate the present apparatus is and the present theory. I don't know whether Mr. Zukor, Mr. Lasky, or Mr. Harley Clarke were here tonight but if they weren't they should have been, and perhaps it might offer them some hope of getting the people into the motion picture theaters today if they would put on music of this high quality.

MR. SCHENCK: In your opinion, Mr. Frederick, when these high frequency speakers are playing—we haven't been accustomed to hearing frequencies of that order—were those actual reproductions on that frequency band or would you say there was distortion present?

MR. FREDERICK: There is no question that the day of reproducing sound without distortion is not yet here. Surely there is some distortion there. All I should say is that I think there is a little less than I have often heard, and I hope that five years hence there will be still less.

I waver between two feelings on this whole matter. Some days I quite enjoy listening to some of this music, and most of the other days I feel greatly impressed with the fact that we yet have a long, long way to go. This is not perfect and the day of perfection is a long way off.

MR. SCHENCK: We are not accustomed to hearing the high frequencies reproduced, and I am merely wondering whether we jump to conclusions about the distortion at that high frequency, particularly in connection with the orchestral record, wherein it sounded to me as if the cymbals were playing. At one point in the record it seemed almost certain that there was distortion. Following that, it started to clear up somewhat, and I could hear the high frequency instruments such as the cymbals or the bells that you mention.

MR. STOKOWSKI: Those loud crashes are cymbals. But they are cut off at nine thousand cycles. You need at least thirteen thousand, according to our experiments, and perhaps more. That is why they sounded strange.

MR. CRABTREE: What is the thickness of the records, and how are they made?

MR. FREDERICK: These particular records are about a quarter inch thick. They can be made two-hundredths of an inch thick. They are thermoplastic, not like bakelite. Under the application of heat they soften. They were pressed in the usual manner.

MR. WILSON: I would like to ask Mr. Frederick if the sound level, as it appears to the average person sitting here tonight listening to the orchestral record, is approximately what would be expected in an equivalent position in an auditorium listening to the actual orchestra. It is difficult, looking at a bank of loud speakers, to judge whether one is hearing the true level or something considerably above what he would get from the real orchestra.

MR. FREDERICK: I fully appreciate the difficulty you express of judging whether the level is right. Remember, you always hear an orchestra with two ears. The binaural effect changes your impressions always. You also use your eyes when you hear an orchestra and I think that what you see also changes the general impression quite a lot.

The loudness can, of course, be definitely measured and can be compared under different cases. We haven't actually made such measurements in this hall, but it is my impression that the loudness, both in the case of the organ record and in the case of the orchestral record, was fairly close to the original loudness.

Question on Tracking

MR. EDWARDS: I should like to ask Mr. Frederick about tracking. That is the great handicap of lateral recording, the thing that has given the most trouble in projection.

This is the first time that I have seen a reproducer that hasn't depended for its trackage on a thread and screw.

In the illustration showing the difference between the hill and dale and the lateral recording as placed on the record, I noticed that in the case of the hill and dale recording the wall of the record is cut very much lower than the surface level. Would not a little wear cause a great deal of difficulty in tracking, especially with the free reproducer?

MR. FREDERICK: I don't think I have ever seen one of these fail to track. We have had practically no trouble at all from this. I don't doubt there may be cases where they haven't tracked, but I don't remember ever seeing one. That hasn't been one of our difficulties.

MR. EDWARDS: I think possibly the most notable example of detracking in a lateral record was in the picture, *Lilac Time*. In that picture there was a shot in the center of one record, and I think that shot must have cost the producing company a matter of twenty-five thousand dollars for that record because, once played, the next time it went through the wall. It brought disastrous results to everybody concerned.

MR. FREDERICK: Of course, with a lateral record, if an extra broad deviation of the groove occurs there is danger of cutting over into the next groove. With the vertical cut, even when the cutting stylus leaves the wax entirely, we have never experienced any difficulty in tracking. There is some distortion, of course, due to the fact that the top of the wave has been cut off. But it tracks perfectly well. And I think that is a rather important practical advantage of the vertical as opposed to the lateral type of record.

MR. CRABTREE: Might I ask Mr. Stokowski to tell us what is lacking in the music from a musician's standpoint? First of all, is the volume adequate? Do you get the thrill from the reproduction that you do from the actual orchestra? Is it lacking in depth or static effect? Do you notice the lack of perspective in it?

It is only by criticism of this kind, of course, that we can really advance; find out what is lacking and then try to improve it.

MR. STOKOWSKI: As to volume range, it is approximately, in my opinion, the same as in the original orchestra, but in frequency there is a departure. The cymbals don't sound like cymbals because, as I said before, they are cut off at about nine thousand cycles and they need thirteen or fourteen thousand. The range between nine thousand and thirteen or fourteen thousand is necessary for several other instruments to give the proper tone color. It is a pity we do not have a word in the English language for timbre. We ought to invent one, because we need technical terms which have an exact significance and are invariable in their meaning.

We have in Philadelphia, in the monitor room (a room, I suppose, about one hundred and twenty feet long, so that there is plenty of space in which the tone can develop), the Bell Telephone Laboratories' loud speaker, different from this one. This is a double speaker; we have a triple loud speaker there, wired from the microphones in the hall. We have usually three, four, or five different microphones in different positions, so we can switch from one to the other.

When we sit in that room, which is soundproof, we don't hear the original. We hear the music only from the loud speaker. And we have there a most wonderful and faithful reproduction of the orchestra. I go in and conduct the orchestra for a time, to get the direct sound of the orchestra. Then I go down the hall about two-thirds of the way and listen to the orchestra from that point, which is the average listening point for the public. Then I go into the monitor room and compare what I hear there with what I heard outside, and it is a very faithful reproduction.

Result of Comparison

From that comparison I notice that if we cut off from about 15,000, as we have done there, down to 9,000, we not only cut off those higher frequencies, but there is some relation between those high frequencies and the ones which exist from 9,000 downward, and they, too, are changed. The frequencies ranging from one to five thousand should remain the same when the frequency range is cut down to 9,000 but, to the ear, they don't remain the same. They are changed in some way. You get a totally different sound. And that is, I think, one thing that will be gained when we have still higher frequencies than this, which we undoubtedly will have, because we already have them in Philadelphia.

MR. RICHARDSON: I believe that this style of recording will meet with trouble in the projection room due to the abrasive effect of dust in the bottom of the groove where the pressure must come from the needle. It must be borne in mind that the conditions in the laboratory and those in a projection room are quite different, particularly in the smaller theaters.

MR. HORNBLOWER: I should like to know whether, in checking the original against the reproduced sound of the symphony, consideration was given to the fact that the symphony orchestra would occupy a stage as large as the one you are standing on, that your base drum would be, say, thirty feet from the first viol, and so on, while in reproducing you get everything within an area six feet square.

MR. FREDERICK: I tried to bring out that point before, that one of the limitations of this type of reproduction is that we are effectively listening with only one ear, picking up with a single microphone, whereas under normal conditions, in a hall, we hear with both ears, and the orchestra is spread out.

We have taken that fact into account in some recording work by placing the microphone at an adequate distance from the orchestra.

In the particular orchestral record which we played here, we were obliged to have the microphone close to the conductor's stand, which we know is an atrocious place for it; but it was impossible to place it anywhere else, and I am quite sure that the record was very much injured as a result of it.

Theory and Fundamentals

By W. W. JONES

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Engineering Department of RCA Photophone and has been closely identified with the educational activities of that organization since the time of its inception. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that institution.—THE EDITOR.

Oiling Projection Equipment

IN these days of sound pictures, during which we have been particularly interested in the mechanics and principles of sound reproduction, it is highly probable that we are apt to overlook or to underestimate the importance of consistent and proper lubrication of projection equipment. It should be remembered that projection equipment in most theatres is operated eight to ten hours a day for three hundred sixty-five days a year. This represents approximately 3,000 to 4,000 operating hours.

If machines are to operate under these conditions without mechanical failure and yet continue to project the same quality picture, and reproduce the same quality of sound they must be lubricated properly and consistently. By proper lubrication is meant: first, the selection of the proper grade of lubricating oil or grease for the particular application; second, and most important, the application of the oil or grease in the proper quantities to the bearing or moving parts at regular intervals during the operation of the equipment.

Properties of Lubricating Oil

A good lubricating oil should possess the following properties: It should have minimum cohesion among its own particles, that is, the oil should shear easily and should not be gummy. It should have maximum adhesion to the bearing or shaft surfaces to be lubricated, that is, the oil should easily wet the surface to be lubricated. It should be free from acids, and it should be pure.

In operation the lubricating oil forms a thin film between the bearing surface and shaft. If the oil possesses maximum adhesion it wets and adheres best to the bearing and shaft surfaces. When the shaft rotates in the bearing the thin film of oil is sheared into two layers, one sticking to the bearing surface and the other to the shaft surface. This shearing process is aided if the oil has minimum cohesion between particles. Also the better the ability of the oil to wet the shaft surfaces the less likely is the oil apt to run off the shaft or out of the bearing.

Acid is used in refining lubricating oils, and if it is present in the oil used it will attack the metals in the shaft and bearings, and any other metals with which it may come in contact. Likewise, if the oil is not highly refined it will be unstable, and if exposed to the air in warm or hot temperatures it will oxidize and form acid.

A pure lubricating oil is free from water which may cause the oil to emulsify and thus destroy its lubricating qualities. It is free from dirt or any foreign substance which may clog oil wicks and holes, and which may cause excessive wear to bearings. Water in oil also will clog the oil wick.

Selection of Lubricating Oil

All that has been stated above is particularly applicable to lubricating oils to be used for projection and sound equipment.

In selecting a lubricating oil for any purpose it is common practice to consider the following points: The load on the bearing or moving surfaces, or more specifically the bearing pressure. The speed and diameter of the shaft, or the velocity of the moving parts. The temperature at which the bearings or moving parts operate. And a careful consideration of all those points stated above under the properties of oils.

It may be said in general that the load on the various bearings in a projector or sound attachment is low. There is a general statement among lubricating authorities that the principle underlying all lubrication is to use the least viscous oil which will yet completely lubricate and stay on the bearing surface. From this general statement we reason that since the bearing pressures in a projector or sound attachment are low it is not essential that we use a highly viscous oil. Keeping this point in mind we will later see more clearly how we take advantage of this fact in reducing bearing friction running load.

The viscosity of an oil determines the degree of fluidity of the oil, and it also determines the internal friction or ability to withstand shearing. The higher the viscosity, the greater the internal friction caused by the added cohesion between particles.

If an oil of higher viscosity than is necessary to withstand the bearing pressures is used, this only increases the drive motor load and the load on the various gear trains of a projector. The fluid load friction offered by the oil, of course, will depend upon the speed at which the projector is driven.

Since all projectors are now driven at approximately one speed, the only method available to reduce the frictional load is to select an oil of the least viscosity which will maintain proper lubrication with a reasonable degree of safety. That is, the oil should be as light as possible and yet not so light that the pressure of the shaft on the oil film will force it out of the bearing.

We have all observed that any oil is more viscous the colder it gets, and likewise less viscous the hotter the oil is. It is important, because of this property of oil, to know approximately the temperature at which the oil is to operate, so that the oil having the correct viscosity at that temperature can be selected. In this country the viscosity of oils of this class is specified in Saybolt seconds at 100 degrees Fahrenheit. This means that a given quantity of the oil would pass or pour through a standard opening in so many seconds while the oil is at a temperature of 100 degrees Fahrenheit.

While the above statements have had to do particularly with projector and sound attachment bearings they are also applicable as well to other parts of the projector such as the intermittent.

Intermittent Oil

A projector intermittent oil should be low in viscosity in order to reduce the fluid friction load. Intermittent movements are designed and built with very close tolerances. It is, therefore, essential also to use low viscosity oil so that it will reach all moving parts.

An intermittent oil should be entirely free from acids because this will pit and corrode the highly polished parts of the mechanism. It should be entirely free from any trace of water, because the churning action of the movement will cause the oil to emulsify and foam, and thus reduce its lubricating value. It should be free from grit and dirt or any other foreign matter. It should be a highly refined mineral oil so as to prevent oxidation and the formation of acids, and so as to remove all tendencies for the oil to gum after it has been in use.

It is common practice in the oil industry to add animal fats or vegetable fats to mineral oils for certain applications in order to increase the adhering qualities or oiliness of an oil. It is known also that this practice will cause the oil to become unstable, that it will oxidize and become acid when exposed to the air. It is recommended, therefore, that oils not particularly selected for intermittent use be not used.

It was stated at the beginning of this discussion that probably the most important factor in the proper lubrication of a projector is the systematic and consistent application of oil or grease as required.

Since practically all projection equipment is fitted with only oil pipes or oil holes in bearings it is necessary for the projectionist to oil each bearing periodically with an oil can. This method of lubrication, while not unsatisfactory, is at best a poor method. Unless a projectionist is extremely careful he will either put an excess of oil in the hole, causing it to overflow and spatter to other parts of the apparatus, or he will fail to supply a sufficient quantity of oil for proper lubrication.

Care of Intermittent

While an adequate lubricating system has been provided for the intermittent it nevertheless requires constant attention. Care should be exercised to see that the proper level of the correct grade and quality of lubricating oil is maintained in the intermittent reservoir.

Since the intermittent is the heart of the projection equipment it should be dismantled, adjusted and thoroughly cleaned and refilled with fresh oil at least once every two months. The intermittent is the hardest-worked part of the entire projector. It has to start and stop 1440 times a minute, and it deserves the best care one can give it.

Cleanliness Important

The entire projection equipment should be maintained thoroughly clean. Dust and grit should never be allowed to accumulate on the equipment, for it seems that all dirt and grit finds its way into the oil holes, and finally into the bearings. Particles of film should not be allowed to accumulate, to be washed into bearings during regular oiling or by excess oil.

Oil pipes and bearings should be flushed out and cleaned periodically. Wicks and packing in oil pipes should be replaced from time to time. In order to reduce the amount of dust and grit accumulation on the projection equipment, the projection room should be well painted, floors, ceiling and walls.

Unless the projectionist feels that he has satisfied the above conditions in the selection of an oil he should continue to use the oil recommended by the manufacturers of his equipment.

Patents:

A department established for the solution of patent difficulties.

By RAY B. WHITMAN

Readers are urged to avail themselves of this free service for advice on the subjects of Patents, Trade Marks, Designs and Copyrights. If a personal answer is desired, a stamp should be enclosed with the inquiry; otherwise the question and its answer will appear in this department in the first available issue. Address all questions to the Patent Editor in care of THE MOTION PICTURE PROJECTIONIST. *Write on one side of the paper only, giving full name and address and business connection. (Only initials will be published if requested.)*

Q. Is it necessary for the owner of a patent to manufacture and market his invention or have it done for him in order to preserve his rights?—*R. V. W., Detroit, Mich.*

A. No. A patent owner may sleep on his rights as long as he wishes without in any way jeopardizing them. The patent is a seventeen-year monopoly to prevent others from making, using or selling his invention without his consent, and in this country it is not necessary to "work" the patent in order to keep it alive. Inventors, however, are often lax in not making an active effort to sell or license their rights in the very beginning when most of the monopoly is ahead of them and when the patent right therefore is of greatest value. They are often lax in not keeping abreast of conditions in that industry to be sure that no one else innocently infringes their patent, for once knowing of such an infringement they might well be on the road to a fortune because of it.

Q. Can a patent be invalid before it has been adjudicated in court?—*J. R. V., Minneapolis, Minn.*

A. No. A patent is prima facie valid by virtue of its having been issued as a patent and until some court decides otherwise, it is always a perfectly good patent and should be so construed by the inventor. However, those who infringe the patent may have their own opinion as to its validity and may decide to take the risk of continuing such infringement in the belief that if the patent is ever adjudicated it would be held invalid and therefore its use would have cost them nothing.

Q. How can a manufacturer know whether a patent which he is about to buy is worth anything? And, if so, how much?

A. Every prospective buyer of a patent should have a reputable and skilled patent attorney make first a title search to be sure the seller of the rights is the bona fide and sole owner of them; and, second, a "validity and scope" search to determine the strength of the patent and its probable validity if later contested in the courts, and the buyer should not buy unless the title search which is made in Washington is perfectly clear and the validity and scope search results in an opinion by the attorney that the patent is practically certain to be held valid if adjudicated and that its scope would be interpreted as ample to cover the situation of the purchaser. A title search costs usually $25.00 or $60.00 and a validity and scope search from $100 up, depending upon its complexity.

Q Is there any advantage in keeping a patent application pending as long as possible?—*E. S., Quincy, Mass.*

A. Yes, there is. Unless actual infringement of the allowed claims is known, it is not wise to hasten unduly the prosecution of an application, for the reason that corrections and amendments which can be made during the prosecution of the application cannot be made after the grant of the patent, except by having it reissued, which is sometimes difficult or impossible to do. It is expensive, and also risky, giving rise, for instance, to what is termed "intervening rights," which may render the patent valueless against the particular people you would want to sue.

Q. Where one secures a patent for an improvement on any machine, would the owner of the patent covering the improvement have the right to buy the patented machine in the open market, attach his patented improvement and resell it?—*F. H. W., Jonesboro, Ark.*

A. Yes. As long as you buy the article in the open market you have paid for the right to use it and in effect have a license for that one article under any patent covering it. You can, therefore, add safely any improvements of yours and resell it.

Theatre Staff Develops Histrionic Complex

The State Theatre, of Baden Karlsruhe, has made a film, with the parts played by members of its own company. The idea is to use the film as a weapon to fight the "Publikumskrise" or theatre crisis. The film, which is about 2,000 feet, has as its subject the history and traditions of the former Court Theatre in Karlsruhe and incidents out of the society life of the Baden Residence in the 18th and 19th centuries. Economic conditions in Germany tend to keep the public out of the theatre and so this film has been made in the interest of actors and theatre staff with a view to reviving trade and inducing the public to visit the theatres.

New Equipment and Appliances

Novel Film Scale

A new film scale of the direct reading type, which indicates instantly and with the utmost accuracy the exact footage on a reel and also the running time, is now being marketed by the Utility Sales Company of New York.

The scale, which is of such dimensions that it may be conveniently carried in the vest pocket, is made of brass with polished letters on a black etched ground. It is said that actual tests have been made showing that the scale will indicate running time within one minute in a ten reel program.

"Treatizor" Film Cleaner

A NEW film cleaning device known as the "Treatizor," which is designed not only to remove oil, dirt, gum and grease from motion picture film, but also to lubricate the film as it passes through the projector, has just been placed on the market by the Blue Seal Products Company, of Brooklyn, N. Y.

The "Treatizor" is shipped from the factory assembled as one unit and may be installed by the projectionist by means of a few simple operations requiring less than five minutes. The procedure consists merely in removing the upper magazine and film valve casting from the projector, mounting the new device and replacing the magazine. A tank, which forms a part of the device, is then filled with a special fluid and, after a slight adjustment to regulate the flow, the assembly is ready for operation.

An additional feature of the attachment is that the tank has a lead to a safety valve which is placed over the picture aperture. This valve is automatically released should a fire break out in the upper film loop and the entire content of the tank is shot into the projector thus dousing the fire.

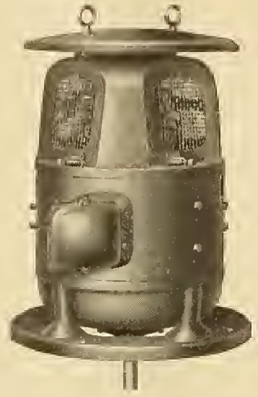
In composition the fluid provided is made up chiefly of carbon tetrachloride which is combined with other chemicals that have been incorporated because of their lubrication value as well as their action as film preservatives.

The fluid is applied to the film by means of two felt pads through which the film is passed in the threading process. The function of these pads is not only to supply the fluid but also simultaneously to remove foreign matter.

D.C. Vertical Motor

THE Century Electric Company of St. Louis, Mo., announces a direct current motor designed for vertical operation. The machine, which is known as the Type R, has been placed on the market in response to a demand for a motor having other than the usual horizontal drive.

The motor is of the ball-bearing type and is grease lubricated. It is mounted on a ring base, or may be mounted directly on the driven equipment if desired. The top bracket is protected by a cover and can be furnished either open or with a solid cover to meet surrounding conditions. The unit is built in sizes from 1 to 150 horsepower.



C. W. Bunn Issues Statement on E.R.P.I. Service Charges

Trouble preventing inspections, appointment and emergency calls, replacement part inventories in key cities, free replacements, repairs and improvements, general administrative expenses and protection against fire loss are the things that the service dollar pays for, C. W. Bunn, general sales manager of Electrical Research Products, stated recently in outlining how service charges have been brought to a minimum consistent with the maintenance of high quality of reproduction and continuous, dependable operation.

Only 4.3 cents of every dollar goes to administrative and engineering expenses.

The regular inspection service takes 54.1 cents and emergency and appointment calls account for 13 cents. The former comprise the regular trouble preventing inspections made by a field force of 600 who travel 5,720,000 miles annually among 5,500 Western Electric equipped theatres. Appointment and emergency calls are additional visits, the former to discuss problems of equipment maintenance and operation by appointment and the latter in response to an immediate emergency.

Experience gained in contact with 8,000 theatres has demonstrated, Mr. Bunn stated, that a definite relationship exists between the number of inspection and emergency calls. The latter at present average one per theatre every 18 months. Any attempt to economize by cutting down the inspection calls would automatically increase service costs by a resulting larger number of more costly emergency calls, Mr. Bunn explained. Even more important, he pointed out, would be the menace of interrupted and canceled shows resulting from lack of sufficient inspections.

Thirteen cents out of every dollar goes for the maintenance of $750,000 replacement part inventories in 35 key cities and of 173 other service points. These assure maximum freedom from program interruptions because of the ability to replace speedily parts in an emergency.

Out of every service dollar 4.6 cents goes for free replacements, repairs and improvements made by Electrical Research Products without charge to exhibitors. This activity was initiated last year without any increase in service charges and is estimated to have saved exhibitors $750,000 in one year. It also finances the Inquiry Bureau in New York, organized in 1931 to cooperate with exhibitors in supplying adequate information regarding equipment operation and maintenance.

The final 11 cents out of the dollar goes for protection against fire loss. It assures the immediate replacement of any equipment or parts damaged by fire without a lost moment for technical formalities or the signing of papers.

Conclusions Drawn

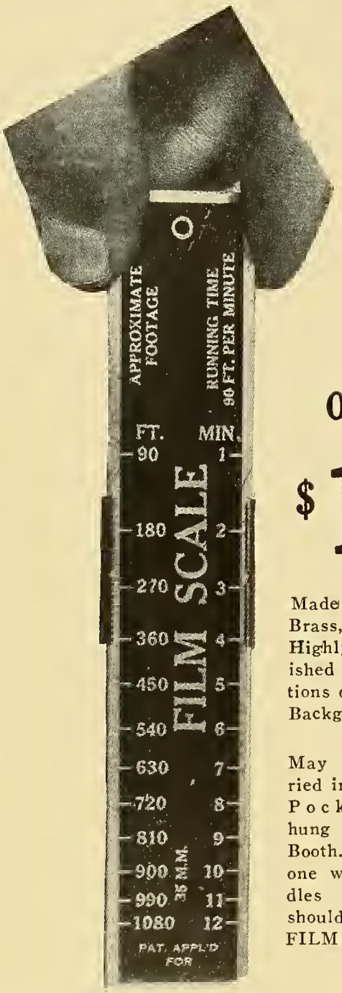
"We have reduced charges to the absolute minimum consistent with satisfactory reproduction and the greatest possible promise of continuous, dependable performance. In our estimation these are the foremost box office considerations. Whenever we have been able to effect economies without jeopardizing them, we have promptly passed the exhibitors the savings in the form of reductions in service charges.

"The best assurance that we have acted wisely in placing quality reproduction and steady performance first lies in the fact that only 5 per cent of the Western Electric equipped theatres are closed today as compared with 50 per cent dark houses among theatres with competitive types of equipment. We are unable to escape the conclusion that the quality of sound and its steady dependability of operation have been big factors in enabling Western Electric equipped theatres to hold patronage and make such a favorable record, by comparison with others, under present conditions," Mr. Bunn said.

Simple
Accurate
Essential

35 M. M. FILM SCALE

. . . Belongs in your TOOL KIT



Only $1.00

Made of heavy Brass, Etched, Highly Polished Graduations on Black Background.

May be carried in a Vest Pocket or hung in the Booth. Every one who handles FILM should have a FILM SCALE.

GAUGE your own running time. FILM SCALE will tell you with the utmost ACCURACY the exact length of the film on the reel—it will tell you with perfect precision the length of time necessary to run that reel through the projector. No more guesswork.

Every PROJECTIONIST should own one and save a load of guesswork and trouble.

Fill in COUPON—pin a dollar to it

UTILITY SALES CO.
7 West 44th Street, New York City, N. Y.

Enclosed find $1.00 for one FILM SCALE and DIRECTIONS.

Name ....

Address ....

City........................ State................

THEATRE ....

Rotating Electrical Machinery

(*Continued from page* 11)

for the engines for quiet operation and sets of low speed should be furnished for the same reason. One of the sets used for this purpose is illustrated.

Installation of Equipment

It is advisable to use conduit wiring throughout and provision should be made on all motors, motor-generators or converters for terminating the conduit in suitable conduit terminal boxes mounted on the machines. The terminal boxes should, of course, be of ample size so that the connections may be readily soldered and taped inside the boxes.

Control panels and filter panels should be so constructed that the operator cannot come into contact with any live part. A convenient arrangement is to mount the filter equipment in a steel box, arranged for wall mounting. If meters are used they should be of the flush type mounted in the front of the box. Rheostats should be mounted inside the box with the control handle in the front. Panel boxes of similar construction are often mounted on the machines. These boxes are, of course, provided with conduit knockouts for terminating the conduit wiring.

It is important to provide suitable solid foundations for motor-generator sets. Concrete is, of course, advisable wherever possible. If the sets are mounted in locations where the operating noise might be objectionable they should be mounted on some kind of sound absorbing material such as cork, rubber or one of the special compounds available for the purpose.

Should be Accessible

It is important to install motor-generators in accessible locations. If they are installed in such locations that it is difficult to get at the bearings or brushes the attendants will not take the trouble to service or inspect these parts. It is usually advisable to install motor-generators or converters in a separate room, such as the battery room and to install control and filter panels in the operating booth, or in a location easily accessible from it. In that case the filter and control panel will be arranged for wall mounting with conduit knockout and conduit wiring would be used between the generators or converters and the panel boxes.

The most important consideration in connection with maintaining rotating electrical machinery is to give the machines proper lubrication. By proper lubrication is meant the right amount of oil or grease. Too much is even more disastrous than not enough. Three general types of bearings are used in these machines, namely, ball bearings, sleeve bearings with wool packed lubrication, and sleeve bearings with underfeed wick lubrication.

Machines with ball bearings are usually shipped with sufficient grease in the bearings to run several months. If the machines operate continuously the ball bearings should be greased every four to six months, depending upon the hours a day they run. In greasing ball bearings it is most important to use clean grease, only a very small amount of dirt or grit in the grease will soon destroy the best ball bearings obtainable.

Some ball bearing machines are furnished with compression grease cups. When compression grease cups are supplied there is a great temptation for the maintenance man to use too much grease. He wants to make sure that the bearings are lubricated and he sometimes keeps adding grease and forces it into the bearings by screwing down on the grease cup. This often results in grease being forced past the bearing into the machine. In some cases the whole machine is filled up with grease which may cause short circuits and prevent the operation of the machine.

Another Method

In other cases no compression cups are furnished, but two plugs are provided, one at the top and the other at the bottom of the bearing. With this arrangement both plugs should be removed and grease should be forced into one until clean grease comes out of the other. This does not put any pressure on the grease and it cannot be forced into the machine. It is advisable to remove the cap which covers the end of the bearing about once a year and clean out all old grease and replace it with new. When doing this great care should be taken to see that no dirt is allowed to get into the bearing.

In the wool packed sleeve bearing absorbent wool yarn is packed around the bearing and in the oil reservoir below, the absorbent wool carrying the oil from the reservoir to the shaft. Before operating the machine with wool-packed bearings the oil reservoir should be filled with a good grade of engine oil until the oil appears at the overflow at the side of the bearing. For machine operating continuously, wool-packed bearings should be inspected about once a month and oiled if necessary. Probably only a few drops of oil a month would be required. Wool packing should not be removed unless necessary and if removed care should be taken to see that it is replaced so that it reaches to the bottom of the oil chamber and rests firmly on the shaft at the top of the bearing.

Machines with underfeed wick-oiled lubrication should be inspected about once a week if they are operating continuously to see that there is enough grease in the grease cup. Where extra large grease cups are used less frequent inspection will be sufficient.

Periodical Inspection

Rotating electrical machines of any kind should be inspected at least once a month to make sure that they are operating satisfactorily. Bearings should be inspected to see that they are receiving proper lubrication and the brushes and commutators should be given attention to see that the brushes are making proper contact with the commutators and to see that there is no dirt or grit present which might cause wear of both brushes and commutators.

If there is any oil or grease on the commutator or brushes it should be carefully wiped off and the operator should investigate to find out where the oil or grease comes from. It is usually the result of the use of too much oil.

Motors and generators used for this kind of service should always be provided with protected covers and when the machines are inspected care should be taken in all cases to replace covers.

It is advisable to carry on hand a reasonable number of spare parts, such as brushes, brushholder, insulation, bearings, and if possible, spare armatures and field coils. In case of high voltage generators it is most advisable to have a spare armature ready. Where the continuance of the performance in the theatre depends on the operation of the electrical machines it is sometimes advisable to make duplicate installations. Besides having a duplicate source of power available it allows machines to be operated alternately, machines not in use being given careful inspection.

Talking Picture Equipment Adapted for P. A. Work

An interesting example of how special equipment for sound amplification and transmission can be arranged in connection with talking picture equipment was offered recently when the Audubon Theatre, New York, was confronted with the necessity of reinforcing a crooning specialty act to penetrate satisfactorily the entire auditorium.

The problem, referred to the Special Projects Department of Electrical Research Products, was solved by the installation of a special Public Address attachment consisting of two microphones, a microphone control panel and two loud speakers to work in conjunction with the theatre's sound system.

The microphones were equipped with outlets and plugging facilities to allow placement at any desired stage location. The control panel was put in the projection room near one of the spotlight positions. It provided means of controlling the amplification and of associating either of the microphones with the main system. The horns were located so as to project the artist's voice beyond normal range and so that patrons throughout the house could hear equally well. With

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

Rheostat leadership may be claimed by many, but we have it—

"Perfection" in name and performance.

Motion picture theatre owners and projectionists from Maine to California endorse our claim and know it's no idle boast.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Specialists

RHEOSTATS

Announcing 85 Ampere 9x20

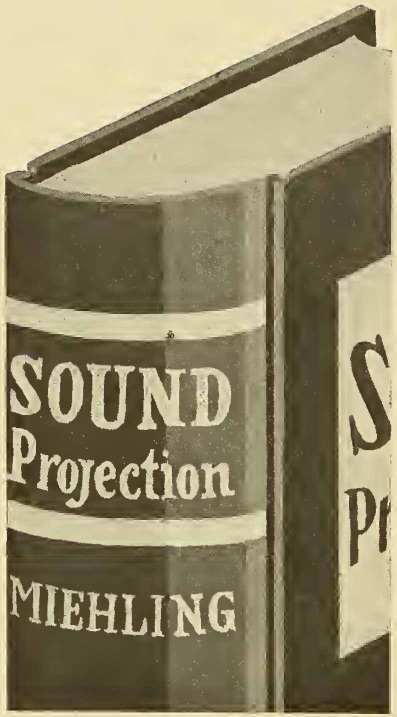
IMPROVEMENTS in the 9 mm x 20 inch National "High-Low" White Flame Projector Carbon permit operation at arc currents up to 85 amperes . . . . .

LONG LIFE STEADY BURNING
EVEN CRATERS

feature the performance of this improved carbon . . .

NATIONAL
PROJECTOR CARBONS

NATIONAL CARBON COMPANY, INC., Cleveland, Ohio
CARBON SALES DIVISION
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York, Pittsburgh, Chicago, San Francisco



STILL PREFERRED

Above All Others

MORE Miehling books have been sold to projectionists than any other . . . . There have been others since Miehling's book was brought out . . . . and some at a lower price . . . . but Miehling's still remains as the *only book written by a projectionist for projectionists* . . . . That it why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of *all* sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.
519 pages . . . completely indexed

THIRTY-ONE chapters, each covering a phase of sound equipment operation, are thoroughly indexed in the back of the book, affording the projectionist full means of reference in case of trouble. The whole set-up of the book has been designed for leisurely reading or for quick use in a breakdown emergency.

ONE hundred and thirty-seven illustrations: diagrams, schematic drawings and photographs are scattered through the book, adjacent to connecting text. Continuity of text and picture is thus preserved throughout. A perfect book for projectionists.

Price $4.00. We Pay Postage

Mancall Publishing Corp.,
7 W. 44th Street, New York City
Send me Miehling's Sound Projection
Enclosed find remittance of $4.00.

Name ....
Address ....
City and State ....
Position ....
Theatre ....

this equipment the theatre was able to stage a take-off of a radio broadcast specialty number.

The interesting part of the job, according to ERPI executives, is that while the installation was made to order to meet special requirements, such special jobs can be executed at any time in connection with existing Western Electric Sound System installations.

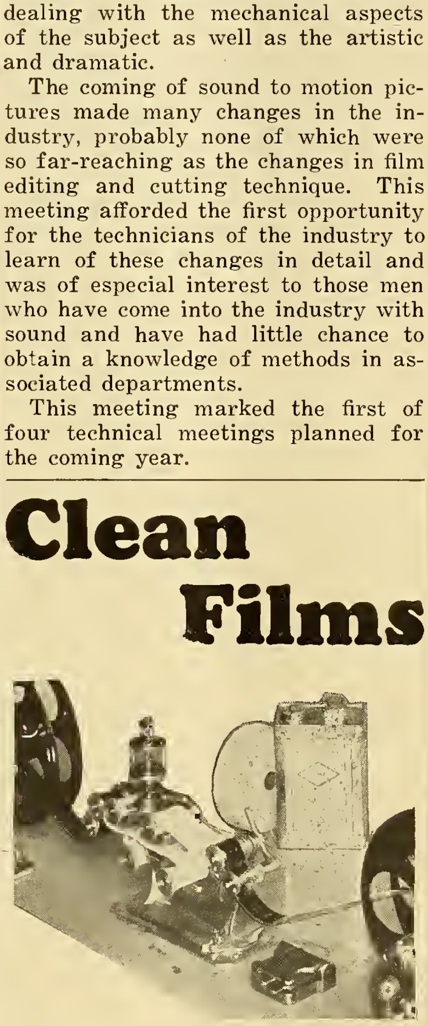
Film Editing Discussed at Academy Meeting

A meeting of the Technicians' Branch of the Academy of Motion Picture Arts and Sciences was held on Thursday evening, March 17. The subject of "Film Editing" was discussed, and papers were presented dealing with the mechanical aspects of the subject as well as the artistic and dramatic.

The coming of sound to motion pictures made many changes in the industry, probably none of which were so far-reaching as the changes in film editing and cutting technique. This meeting afforded the first opportunity for the technicians of the industry to learn of these changes in detail and was of especial interest to those men who have come into the industry with sound and have had little chance to obtain a knowledge of methods in associated departments.

This meeting marked the first of four technical meetings planned for the coming year.

Clean Films



Clean films mean good sound and picture. Our WIPER-CLEANER together with our FILMEX CLEANING FLUID removes oil and surface dirt which is so detrimental to good sound and picture projection.

Write for our interesting booklet

Film Processing Machinery Corporation
354 West 44th Street
New York City, New York

Method for Making a Translucent Screen

The Visual Instruction Service of the Iowa State College suggests the following method for making a translucent screen adaptable to sixteen millimeter projection.

This screen may be prepared at quite a reasonable figure, and when completed gives a good type of screen for the so-called "daylight" projection.

This plan is to project from the rear of the screen thus providing a relatively small picture at a short distance. All of the light is concentrated, giving a brighter picture, which may be easily seen in the subdued light of a classroom, without the extra trouble and inconvenience of darkening the room.

The following is the method of procedure in making one of these "daylight" screens:

Take a piece of engineer's tracing cloth and impregnate it with a solution of paraffin at 54°, dissolved in zylol or benzine. After doing this, smooth with a warm iron. Reinforce the edges with some heavy cloth such as a light grade of duck and put holes in it so that it may be stretched from each corner with rubber bands, or it may be tacked inside of a wooden frame.

Tracing cloth, without the paraffin treatment, may be used to good advantage, as may be also a good grade of tracing paper.

The Optical System, Its Effect on Sound

The quality of the sound output varies in accordance with two factors, which are, actual slit width and rotational adjustment of the slit. In practice it is found that sound quality varies also as a third factor varies. This third factor is found to be the focussing adjustment of the condenser lens assemblies. The light from the filament of the exciter lamp is focused upon the slit by the condenser lens assembly located between the exciter lamp and the slit.

In one type of commercial equipment this adjustment is extremely delicate and is accomplished by racking the exciter lamp laterally, horizontally and vertically. In other types of commercial equipment this adjustment is not quite so critical since, in these types of equipment, an image of the slit is focused upon the film rather than, as in the case of the first example, an image of the filament. This adjustment is secured, generally, by moving the exciter lamp as required until the light passed by the optical system shows as a clean round spot of light upon a card inserted in the sound head just in front of the photocell condensing lens. If the adjustment is not correct the circle of light will not be complete.

In such an event, the lamp is re-positioned until the circle is complete. On all types of soundheads setscrews or knurled clamping screws will be found. These are used to clamp the lamp in position after it is properly located. Spare lamp holders provided to eliminate stoppage of the show in the event of an exciter lamp burn out may contain carefully prefocussed lamps.

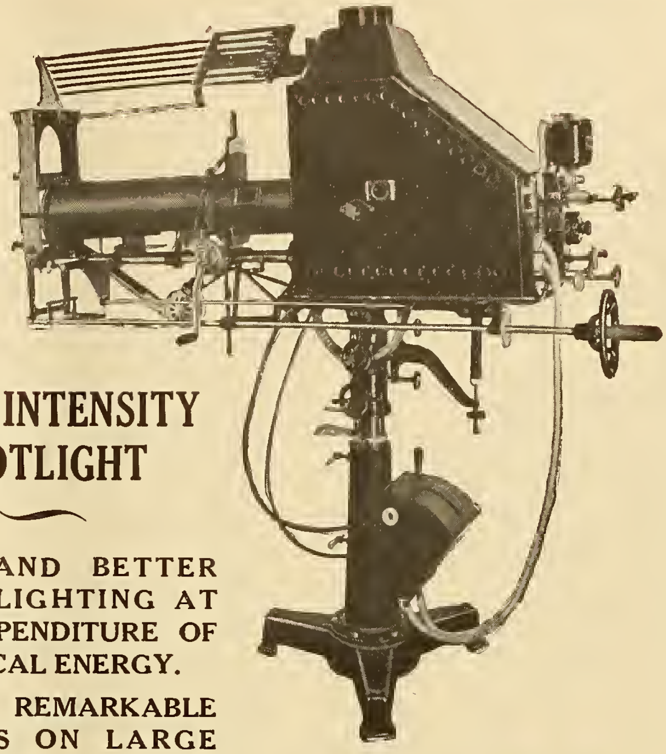
Necessitates Great Precision

The adjustment of the lens and slit assemblies is very precise and cannot be satisfactorily accomplished by listening to the sound or by inspection of the thickness of the beam. The service engineer has film and meters whereby he can adjust these items to their optimum position. In general his procedure is simply to thread up the projector with a special high frequency test film, connect the necessary meter to the output of the amplifier, run the film and adjust the optical system until the output of the reproducer is at a maximum. This involves the careful setting of the slit for rotational adjustments in order to avoid the distortion caused by such misadjustment, and the careful focussing of the objective lens assembly so that the width of the beam at the film is at its most narrow value. Before actually setting the optical system the service engineer usually sets the position of the guide rollers so that the film passes through the sound gate in the proper position.

Permissible Adjustments

In certain commercial equipments the only adjustment permissible in the field is that of adjusting the position of the exciter lamp with respect to the slit. In these optical systems oil or dirt cannot be removed from inside of the lens assembly in the field but the lens system must be removed, returned to the factory, cleaned and restored to service. In other types of equipment these necessary operations may be performed in the field.

Recapitulating, the optical system consists of a source of light, a lens and slit assembly and the photocell. When the light source is properly positioned and the lens and slit assembly is accurately adjusted a beam of light 0.001 inch wide and 0.084 inch long is focussed upon the sound track of the film. The light, in passing through the film, is absorbed in accordance with the variation in density or area and the remaining light passing through the film impinges upon the photocell. The variation in light striking the photocell produces an identical electrical current which is amplified many times and fed the loudspeakers in the theatre auditorium. In the chain of operations involved in reproducing sound from film, the optical system claims an important share.



HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO.. 844 So. Wabash. Chicago.

INSURE YOUR JOB!
Study F. H. Richardson's
Handbook of Projection
Three volumes containing over 1,400 pages of vital knowledge with question and answer index. Every projectionist needs this authoritative guide. See your local theatre dealer or send for full details.
CHALMERS PUB. CO.
516 Fifth Ave., N. Y.

Give This to Your Friend—Have Him Fill It in and Mail to us at Once

The Motion Picture Projectionist
7 West 44th Street, New York City

Gentlemen:

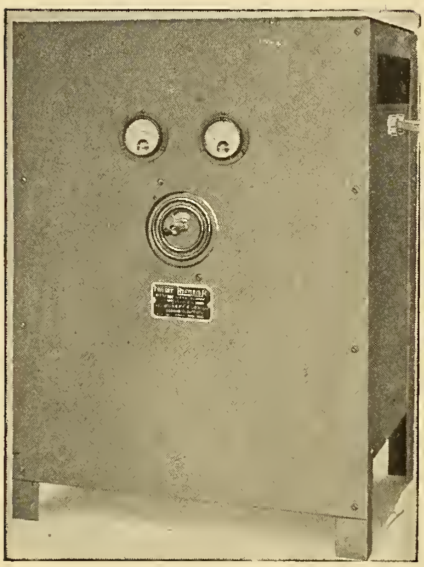
Enclosed please find $2.00 for which enter my subscription for one year (12 issues) starting with..............................issue. (Two years, $3.00.) Add 50 cents for Canadian postage; $1.00 for foreign.

Name ....

Street ....State ....

City ....Local No. ....

Good Projection Requires Good Rectification



M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes, then the other two, as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

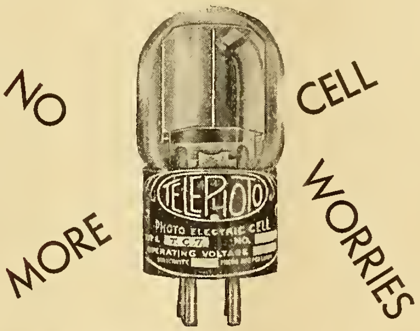
We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP.
New and Wilsey Sts.
Newark New Jersey

Injunction Against DeForest Denied by Court

A statement issued recently by Leslie S. Gordon, president of the DeForest Radio Company, announces that the Court of Chancery of New Jersey, sitting at Jersey City, dismissed on March 10 the unwarranted action of less than one-tenth of 1 per cent of the stockholders to enjoin that company from purchasing the balance of the stock and the assets of the Jenkins Television Corporation. The suit was based on an affidavit by a former employe. This decision frees the Board of Directors to carry out the wishes of the majority of the DeForest stockholders who recently voted in favor of the proposed action.

Some two years ago, states Mr. Gordon, the DeForest company obtained a controlling interest in the Jenkins Television Corporation through an exchange of stock. The boards of both organizations have felt of late that the activities might best be merged for greater efficiency, lower operating costs and more rapid progress in the development and exploitation of television. Although empowered by the corporation laws of Delaware, which apply to both companies, to act alone in the matter, the boards placed the matter before their stockholders and in each case received a majority vote in favor of same.



TELEPHOTO
PHOTOELECTRIC CELLS

A Telephoto cell is not merely another variety of cell—designed to sell in a competitive market. It is constructed of tested materials by master craftsmen and is the final result of serious computation in this field by our laboratory technicians. Its high speed affords action which literally is "quick as a flash."

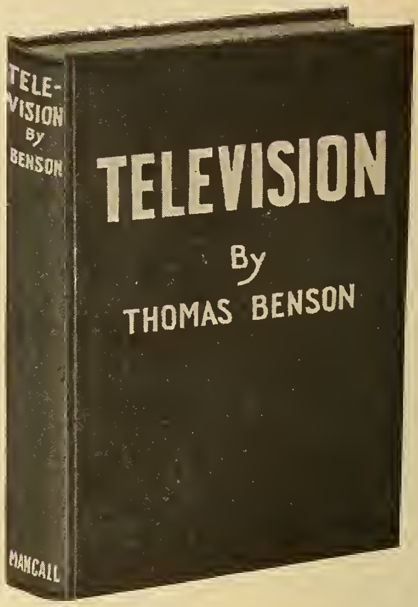
Made in all types and shapes

TELEPHOTO CELLS ARE STANDARD EQUIPMENT IN USE BY LEADING SOUND HEAD MANUFACTURERS.

Pamphlet No. 5 on request

Telephoto & Television Corp.
133-135 West 19th St.
NEW YORK

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today. It is a book both for the interested layman and for the craftsman who will shortly depend on television operation for his livelihood. It has been written especially for the motion picture projectionist who will unquestionably operate television in the theatre as he now does sound equipment. The serious projectionist will get a copy at once.

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

TELEVISION
By Benson $2.00

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th Street, New York City
Enclosed find money order for $2.00.
Please send me Benson's Television.

Name ....
Address ....
City and State........................
Theatre ....

$2.00

SERVICING PROJECTION EQUIPMENT
SERVICING PROJECTION EQUIPMENT

SIMPLE
QUICK

This book is not theory and it isn't history. It is just what its name implies: a practical treatment of common and uncommon projection room troubles and their quick remedies. With it, on your work bench or in your work jacket, you are master of your equipment. Throw the fear of a 'dark screen' out of your mind—this tremendous book will save you from every threatening projection trouble.

Be the BOSS!

The projectionist in the picture *MIGHT* be you. Does he look desperate . . . Does he search tremblingly for the trouble while the screen is dark and the audience stamps, whistles and shouts for the picture?

Not he. With sure fingers and calm, unhurried mind he has gone straight to the cause of the breakdown and he fixes it in a moment. *He is the boss.*

He owns a copy of this book. *YOU* can be like him in an emergency.

Get a copy of this valuable book and Be Boss!

Write to

MOTION PICTURE PROJECTIONIST, 7 West 44th Street, New York City

WHICH SECTION of this new handbook will you use most?

Here are some of the 'TROUBLES' listed and answered in this Service Book

ARC CONTROLLER:

- Device operates poorly
- Device fails to operate
- Device continues to operate after the table Switch is opened.

BELL OR BUZZER SIGNAL SYSTEM:

- Bell (or buzzar) does not operate
- Device operate intermittently
- Bell (or buzzer) sounds continuously
- System works when new battery is used, but soon fails to operate.

DOUSERS:

- Dousers open and close too early or too late
- Dousers fail to operate
- Dousers open or close too far

FILM:

- Film is unusually dry or brittle
- Film adheres in spots
- Film adheres throughout its entire length

FILM DURING PROJECTION:

- Film pulls apart in the Projector
- Film runs off sprocket damaging film
- Film pulls apart where obld style friction takeup is used.
- Film rips and tears while being projected

FILM: (INSPECTION AFTER RUNNING)

- Damage noted in film after the first run—in new film especially.

FILM: (AFTER REWINDING)

- Film shows tears and nicks
- Film is unusually dirty and dusty after rewinding.
- "Rain" developes while running the film
- "Rain" developes while rewinding

FUSES:

- Fuse blows out
- New fuse blows after an interval
- New fuse does not blow out but the line remains dead.
- Fuses blow out when arc is struck (where 3 wire system is in use)
- Fuse locating: Easy way to locate quickly in emergency.
- Fuses: Emergency measure when no fuse can be found.

HOUSE LIGHTS:

- Some lights burn too brightly, others are too dim at same time.
- Emergency lights go out, house lights still burn.

LAMPHOUSE:

- Lamphouse is "live" (It is charged with electricity and producers a shock if touched)
- Lamphouse becomes overheated

LAMP MECHANISM:

- Moving parts of the lamp work with difficulty
- Arcing occurs between carbon and jaws
- Carbon jaws pit and roughten
- Arc controller underfeeds or overfeeds
- With Fulco-Speedco (same applies to Motor Gear-Box Types)
- With Peerless Automatic (same applies to Motor Relay types)
- Motiograph Mechanical (same applies to similar types)

HIGH INTENSITY LAMP: (MECHANICAL TROUBLES)

- H. I. Hand feed works with difficulty
- H. I. Arcs between positive, negative and clamp.
- Emergency: Arc current fails when using D.C.
- H. I. Positive carbon fails to feed
- General Electric H. I.
- Powers H. I. (new type G-E)
- Ashcraft automatic
- All types
- Positive carbon fails to rotate or turn in shield.
- General electric and powers improved types
- Ashcraft automatic
- One carbon burns out quicker than the other

MAZDA FILAMENT LAMP: (MECHANICAL TROUBLES)

- Mirror breaks upon insertion or soon afterwards.
- Mirror looks dull or dirty

REFLECTOR ARC LAMP: (MECHANICAL TROUBLES)

- Mirror backing continually chips or flakes off
- Mirror surface pits
- Occasional aperture fires occur when using Reflector Arc.

LIGHT SOURCE:

- No current at arc
- Series arc: One goes out when other arc is struck.
- Polarity changes so that upper carbon becomes negative.
- Brilliance of arc seems less than usual
- Arc is very unsteady
- Arc unsteady, with H. I. Lamp
- A. C. Arc very noisy
- Arc flames badly and burns in a puffy manner
- Arc fluctuates though carbons are right and contacts clean and tight.
- Arc unstable, even goes out, with Reflector Arc lamps.
- Arc amperage very high (Excessive) when arc is struck, becomes normal after arm burns awhile.

LIGHT SOURCE: (CARBONS)

- Crater "Wanders" about
- Carbons have very short life
- Short carbon life with H. I.
- Crater area too small
- Carbon needles, spindles and pencils
- Carbon shattered by striking Arc
- Carbon developes mushroom (button) point (also known as "Freezing of Arc")
- Carbon Core bunrs away, recesses
- Carbon core blows out
- Carbons cause sputtering, hissing
- Carbons burn with Lip or Overhang
- Carbon "Lips" when using Reflector Arc

LIGHT SOURCE: (FILAMENT LAMPS)

- Bulb looks blackened
- Dark spot shows in Filament Coils
- Lamps have very short life
- Mirror images do not fall exactly between Filament images.
- Lamp is blown out when Projector Table Switch is pulled.

LENSES: (OPTICAL TRAIN)

- Condenser breakage excessive
- Condensers become discolored
- Condensers pit badly
- Lenses seem streaky
- Rear element retaining ring binds when element is removed for cleaning.

MERCURY ARC RECTIFIER:

- Rectifier does not work on starting up
- Tube does not tilt
- When tilted by hand, tube does not start; when tilted by shaking magnet, tube does not tilt
- Tube lights, but goes out
- Tube is tilted by shaking magnet but does not return to vertical position
- Tube tilts and returns but does not flash
- Tube tilts, flashes, then goes out
- Tube tilts feebly
- Tube starts and keeps on tilting
- Device is very noisy

MOTORS AND MOTOR GENERATORS:

- Uundue wear and other damages show up
- Coils and winding, especially around Commutator, seem damaged. Weakened insulation is visible.

BEARING:

- Ball bearings are roughened or completely ruined
- Bearings show undue wear
- Bearings are grooved
- Brushes wear excessively
- Brushes stick in holders
- Brushes make poor contact
- "Bucking" (Arcing between adjacent Brush arms)

STARTING TROUBLES:

- Device fails to start when proper starting instructions are followed
- Set operates but does not attain full speed
- Motor revolves in wrong direction
- Set does not pick up readily
- Set does not deliver full voltage

FLICKER:

- Flicker shows when new screen has been installed
- Flicker noticeable when amperage is increased
- Flicker increases when size of picture is increased
- Flicker noticeable with two-wing shutter
- Flicker is noticeable when projection speed is reduced

FOCUS:

- Focus is not sharp: Keystone effect is pronounced
- Focus appears sharp from projection room, but is poor in parts of auditoriuum
- Focus bad, out of focus, in-and-out effect

LIGHT CONDITIONS AND THEIR EFFECT ON THE SCREEN:

- Blue spot in picture or in light in center of screen
- Definition of picture poor
- Detail lacking in screen result
- Dirty, smoky, smudgy light effect on screen
- Light seems to get bright and fade away with A.C. arc
- Light on screen poor with Mazda
- Lacking detail in picture with Mazda
- Light unusually poor with Mazda
- Poor light with High Intensity Arc
- Uneven, unsteady high intensity light
- Poor lighting with Reflector Arc
- Lighting glarey and harsh when light source is changed
- Glare spots show up
- Gray, flat picture; no contrast
- Light shows outside screen area
- Light looses brilliancy
- Picture less brilliant at some points in auditorium than in others
- Light streaky with Mazda projection
- Shadow appears near top, bottom, or side of screen
- Unsteady picture
- Unsteadiness, side motion of picture
- Unsteady picture although Projector is in perfect adjustment
- Picture seems to float about on screen

TRAVEL GHOST:

- Travel ghost shows up
- Travel ghost comes and disappears
- Travel ghost pronounced
- Travel ghost; Picture seems to crawl up on screen
- Uneven light. Noticeable most on plain screen

STEREOPTICON TROUBLES: (NOTICEABLE ON THE SCREEN)

- Stereoptican picture smudgy looking
- Ghost in center of stereoptican picture
- Yellow corners in stereoptican picture
- Both pictures of dissolving stereoptican fail to be in register
- Stereoptican device shows break in a condenser although projector does not
- Shadow of carbons and (or) holders appear when using reflector arc for stereoptican
- Stereoptican slides crack excessively

FILL OUT ~ ~ ~ TEAR OFF ~ ~ ~ MAIL TODAY

MOTION PICTURE PROJECTIONIST
7 West 44th Street
New York, N. Y.

Gentlemen:

Please forward copy of your book, SERVICING PROJECTION EQUIPMENT. Enclosed find two dollars ($2.00).

Name ____________________

Address ____________________

City ____________________ State ____________________

Ordered Today—

Delivered TODAY!

That's
NATIONAL'S WAY

JUST what you need is always in stock at National—ready to go the moment the order arrives. Excuses don't happen. Alibis are out! Every order is a RUSHED ORDER at National, where everybody knows "the show must go on," and they're on their toes to help you keep it going. Carrying full stocks of Genuine Repair Parts and a complete line of Accessories and Supplies of every kind at every film exchange center in the United States, National is organized for speedy service. Projectionists everywhere have found that it pays to—

TRADE WHERE YOU'RE
ALWAYS TREATED RIGHT

NATIONAL THEATRE SUPPLY COMPANY

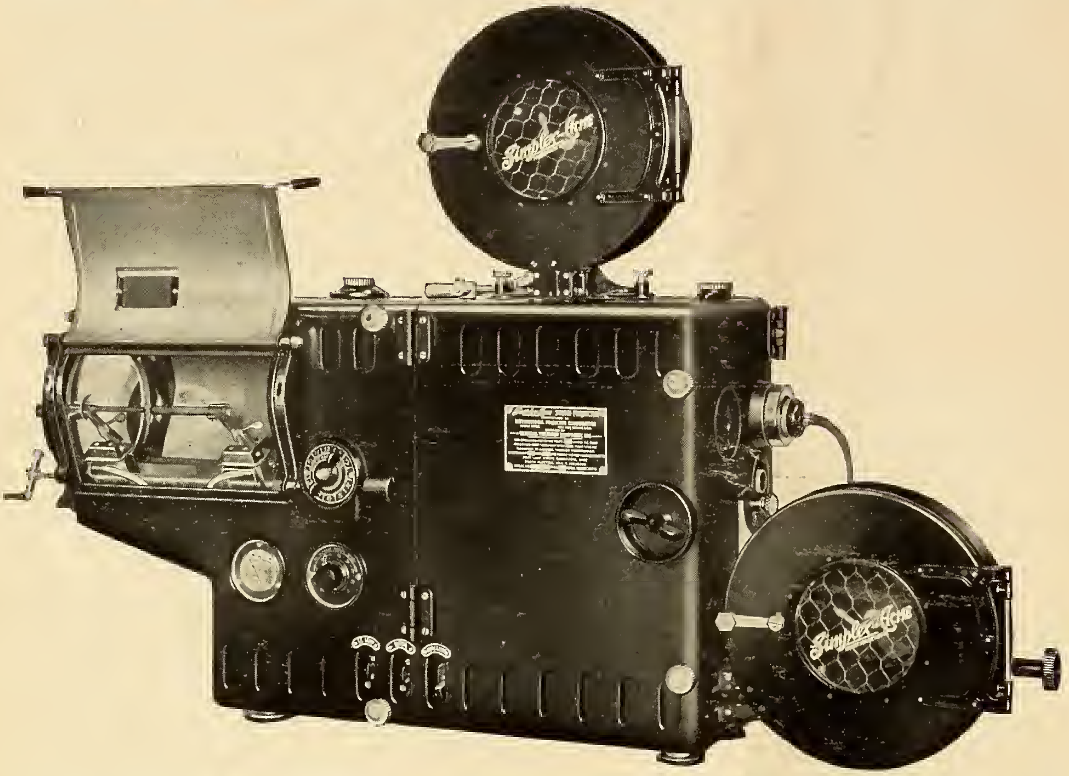
YOUR LOGICAL SUPPLY SOURCE

Simplex-Acme SOUND PROJECTOR

PROVIDES EXCELLENT SOUND
AND VISUAL PROJECTION

FOR

LARGE AND SMALL
AUDITORIUMS



WE ARE RECEIVING LETTERS LIKE THIS ABOUT **Simplex-Acme** SOUND PROJECTORS

FROM THIS COUNTRY AND ALL PARTS OF THE WORLD

SINCERE PRAISE

OF

Simplex-Acme

SOUND PROJECTOR

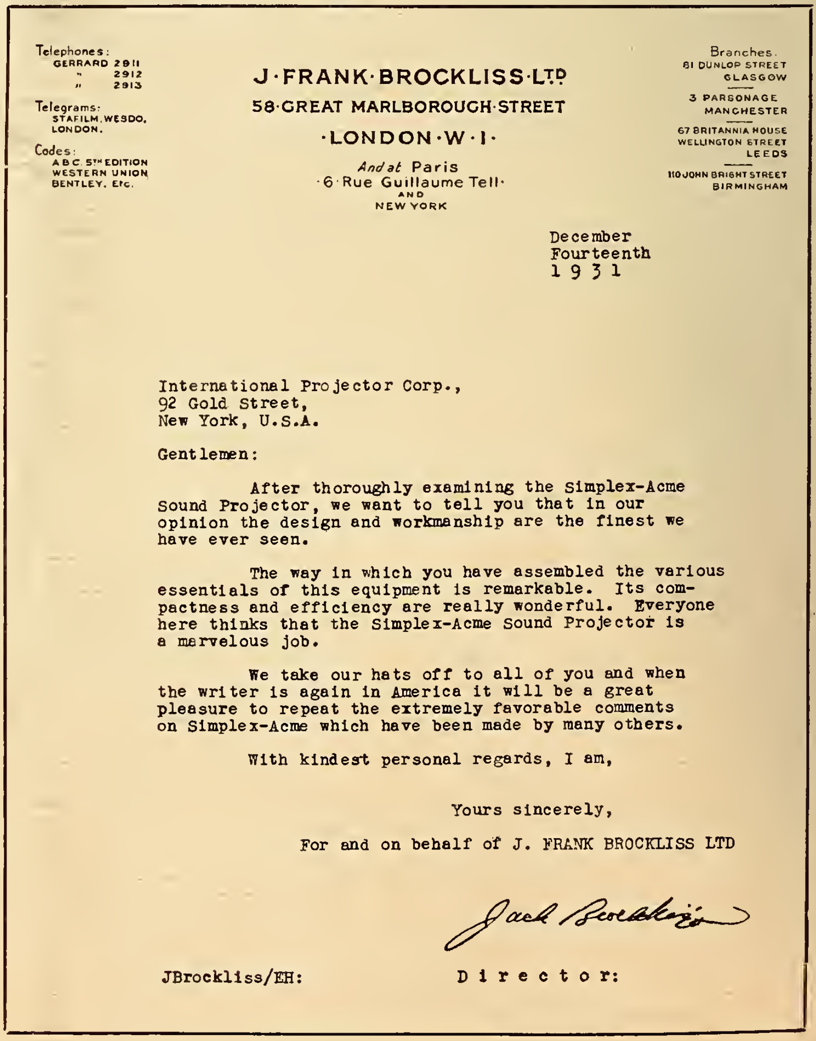
FROM

A SATISFIED CUSTOMER

■

INTERNATIONAL PROJECTOR CORPORATION

90 GOLD STREET, NEW YORK CITY



Telephones:
GERRARD 2911
" 2912
" 2913

Telegrams:
STAFILM, WESDO,
LONDON.

Codes:
A B C. 5TH EDITION
WESTERN UNION
BENTLEY, Etc.

J·FRANK·BROCKLISS·LTD
58·GREAT MARLBOROUGH·STREET
·LONDON·W·1·
And at Paris
·6·Rue Guillaume Tell·
AND
NEW YORK

Branches.
61 DUNLOP STREET
GLASGOW

3 PARSONAGE
MANCHESTER

67 BRITANNIA HOUSE
WELLINGTON STREET
LEEDS

110 JOHN BRIGHT STREET
BIRMINGHAM

December
Fourteenth
1 9 3 1

International Projector Corp.,
92 Gold Street,
New York, U.S.A.

Gentlemen:

After thoroughly examining the Simplex-Acme Sound Projector, we want to tell you that in our opinion the design and workmanship are the finest we have ever seen.

The way in which you have assembled the various essentials of this equipment is remarkable. Its compactness and efficiency are really wonderful. Everyone here thinks that the Simplex-Acme Sound Projector is a marvelous job.

We take our hats off to all of you and when the writer is again in America it will be a great pleasure to repeat the extremely favorable comments on Simplex-Acme which have been made by many others.

With kindest personal regards, I am,

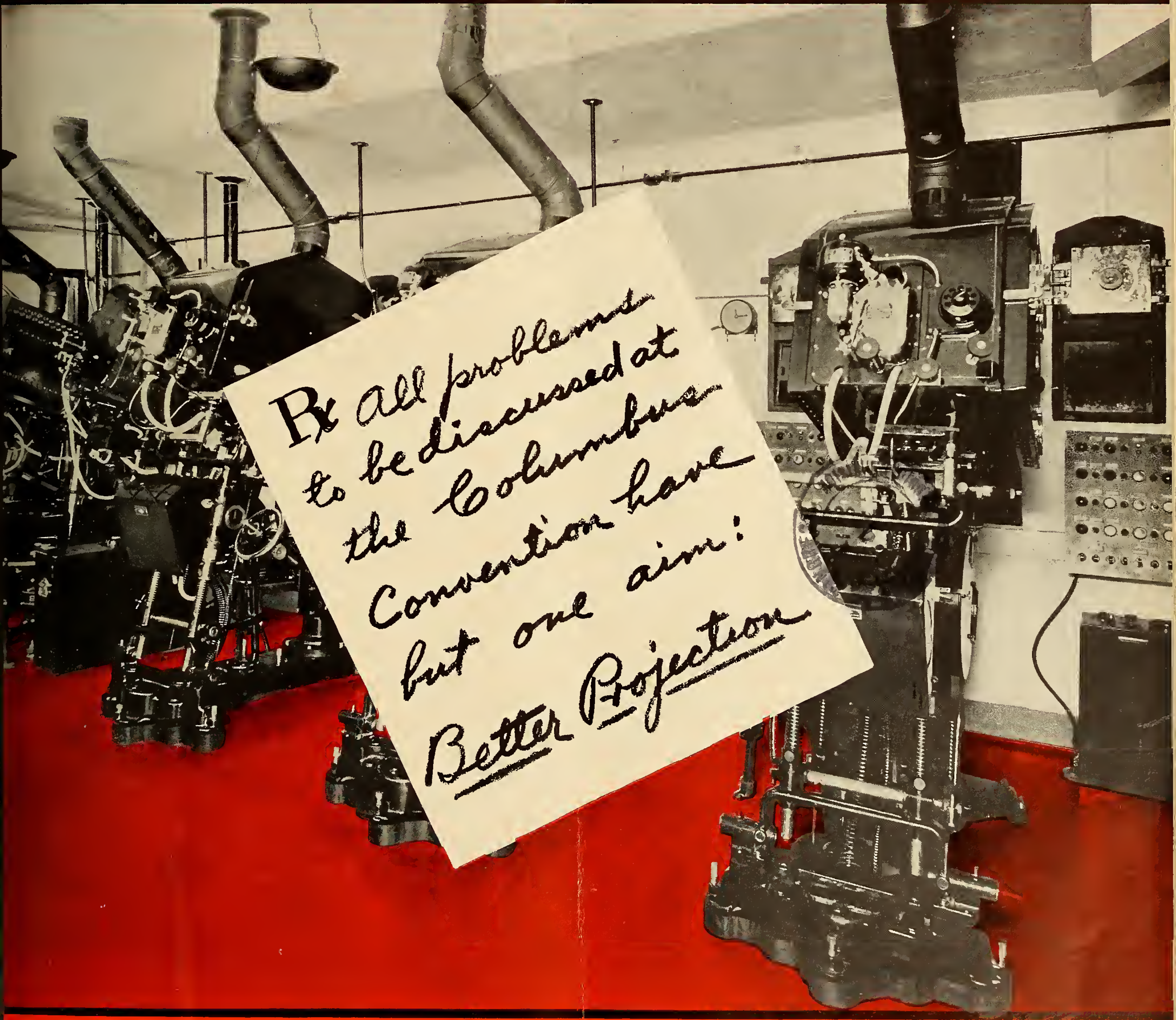
Yours sincerely,

For and on behalf of J. FRANK BROCKLISS LTD

Jack Brockliss

JBrockliss/EH: Director:

MOTION PICTURE PROJECTIONIST

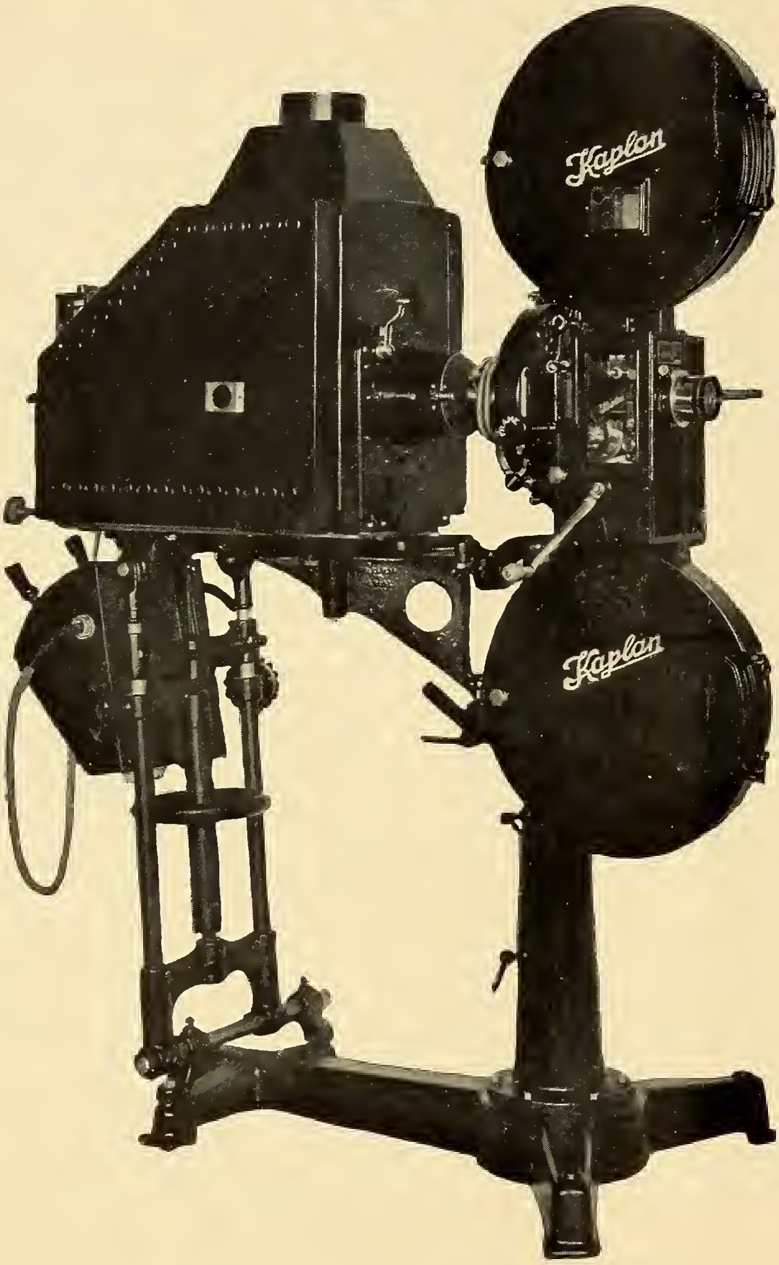


Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.*
Editorial and Advertising Offices, 7 West 44th Street, New York City.
Entered at New York Post Office as second class matter, October 25, 1927.

Vol. 5 • No. 7
25c per copy $2 per year

May, 1932

FIFTH YEAR OF PUBLICATION



Kaplan

PROJECTOR

The Kaplan Projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

An Engineering Product

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue ∴ ∴ New York City

MOTION PICTURE PROJECTIONIST

May, 1932 Vol. 5, No. 7

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Boone Mancall

Editorial & Advertising Office
7 West 44th St.
New York City.

J. E. Otterson Addresses Electrical Association

The great strides science has made in the last ten years in recording and reproducing sound was demonstrated by John E. Otterson, President of Electrical Research Products, Inc., before an audience of 1,000 at a luncheon of the Electrical Association of New York at the Hotel Astor recently.

Mr. Otterson showed how the entire range of sound audible to the human ear—namely, the frequencies from 50 to 10,000 cycles per second—can now be recorded and preserved and likewise reproduced again with complete fidelity.

The scientific achievements which have made this possible, he pointed out, were largely the result of research by engineers of Bell Telephone Laboratories. This research, Mr. Otterson stated, while carried on primarily to improve the art of telephone communication, has actually had a profound effect upon the phonograph, the radio broadcasting and the motion picture industry.

Among those who attended were Mr. Will Hays and Mr. Adolph Zukor.

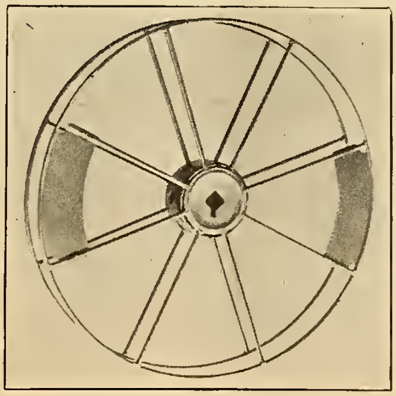
BLOCK OUT SOUND FILM SPLICES THIS EASY, EFFECTIVE WAY

PLACE the film on a special registration block. Coat the film ends, and an Eastman Sound Film Patch, with cement. Apply the patch to the joint. Then pull off the finger tab by which you have been handling the patch . . . and the job is done.

Eastman Sound Film Patches, specially designed and made of opaque film, are simple and clean to apply. They obscure a minimum of the sound track and are practically inaudible in projection. Together with the registration block, they constitute a valuable and unique feature of Eastman service.

Eastman Sound Film Patches, per thousand......$5.00
Eastman Sound Film Patcher (registration block). 4.25

EASTMAN KODAK COMPANY
J. E. BRULATOUR, INC., DISTRIBUTORS
NEW YORK CHICAGO HOLLYWOOD



16 MM
FILM REELS
FOR PROFESSIONAL AND
HOME MOVIES
—ALSO—
35 MM SOUND REELS
10″—11″—14″—15″
UNIVERSAL
ELECTRIC WELDING CO.
9-16 Thirty-Seventh Avenue
LONG ISLAND CITY, N. Y.

ACCEPT NO LESS THAN

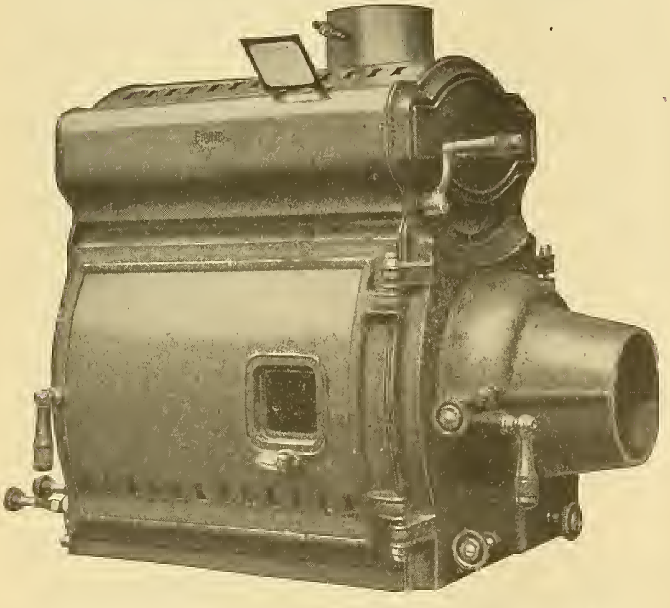
Brenkert

PROVEN PERFORMANCE

Even intense screen illumination always
absolute dependability
low maintenance cost.

Used in the foremost theatres.

A Demonstration Is Convincing



Distributed by Progressive Independent Supply Dealers

Ask Any User

A Brenkert PRODUCT

Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.

Engineers & Manufacturers

ST. AUBIN AT EAST GRAND BLVD., DETROIT

Uniform Aperture Information For Managers and Projectionists

NEW product is now being released with a uniform picture frame size which is the same for all types of prints—movietone, disc and silent.

The new frame size was recommended February 15 by the Academy of Motion Picture Arts and Sciences and has been adopted by the following companies: Columbia, Darmour, Educational, Fox, Hal Roach, Mack Sennett, Metro-Goldwyn-Mayer, Paramount Publix, RKO-Radio, Tiffany, United Artists, Universal and Warner Brothers-First National.

It is the result of months of research to give the theatres the best possible picture frame on standard 35 mm. film. It is intended to reduce the difficulty of exact framing and to do away with the variety of apertures and interchangeable devices which have been an expensive nuisance in projecting sound pictures.

The new releases can be recognized by the fact that the frame lines are about four times as wide as previously. No changes have been made in the sprocket holes or sound track.

An initial minor adjustment of aperture plates and projection screen masks will be necessary to show the new product to best advantage and give the audience the full value of the picture photographed by the studio. When this adjustment has been made as stated below, all prints may be run with the uniform aperture.

The uniform projector aperture for which the new product is photographed is .600 inch high by .825 inch wide. The center line should be .7380 inch from the edge of the film on the sound track side. The corners may be square or rounded to a radius of 3/64 of an inch.

Plates of the specified .600 inch by .825 inch size are obtainable from your supply dealer.

Correctly masking the projection screen is very important. Black material should be masked over the top, bottom and sides of the screen only just enough to secure a sharp edge.

New product is framed from the top of the picture by the studios and should be framed from the top of the picture in projection as well, in order to allow the headroom intended in the photography.

The proportions of the projected screen picture with the new uniform aperture size will be approximately three by four at medium angles of projection and will vary slightly with lower or steeper angles.

To correct extreme keystone, "undersize" aperture plates slightly narrower in width than the specifications are obtainable. The full height of the aperture should be maintained but theatres having very steep angles may, if desired, correct keystone by filing the "undersize" plate on the sides in addition to adjusting the screen masks.

Lenses used for movietone or proportional apertures should be satisfactory for the new uniform aperture. It is desirable that the axis of the optical system be in the center of the projector aperture.

When ordering special trailer service, managers should indicate that trailers are to be made for the new aperture.

For further information refer to local exchange manager; district projection supervisor if in circuit theatre; nearest Film Board of Trade; or write or wire to the Academy of Motion Picture Arts and Sciences, Hollywood, Lester Cowan, Executive Secretary, or to: Paramount Publix Corp., Dr. N. M. LaPorte; Fox Film Corp., E. I. Sponable; Loew's Theatres, Lester B. Isaac; Radio-Keith-Orpheum Corp., L. Roy Cox; Universal Pictures Corp., J. V. Ward; Warner Bros. Theatres, Frank E. Cahill, Jr. Or to: Film Boards of Trade, New York City, A. S. Dickinson; or Society of Motion Picture Engineers, 33 West Forty-second Street, New York City, any officer of the Society; or any officer of the American Projection Society.

As The EDITOR *Sees* IT

¶ *"Seeing Things"*

IT requires no great effort of memory on the part of anyone associated with the industry to recall the extravagant claims of stereoscopic effect which were made during the wide film movement of some two years ago. To be entirely just, these claims did not emanate from the inventors themselves, but rather from their less informed and overzealous camp followers, who mistook the effect of sweeping vista and clever backlighting for true stereoscopy.

This statement, let it be understood, is made in no disparagement of wide film—as such. In the opinion of the writer, based upon the few demonstrations which it has been his privilege to witness, the effects which may be achieved through the use of wide film, granting that the subject has been handled with artistic judgment and photographic discretion, are greatly superior to those obtained with the present 35 mm. black and white print. The major factor entering into any consideration of the reintroduction of wide film is, apparently, economic in character.

Outside of strictly scientific circles, it is doubtful whether there has been, until recently at least, an adequate appreciation of the difficulties which the problems of stereoscopy involve. This is particularly true of stereoscopic vision in its relation to the projection of pictures in motion. This publication is fortunate, therefore, in being able to present in its present issue, through the courtesy of the S.M.P.E. Journal, Dr. Herbert E. Ives' masterly treatise on the subject. Originally delivered in the form of an extemporaneous lecture before the Fall Meeting of the Society, the data were not, until recently, available for publication.

This treatise by Dr. Ives marks in many respects an important contribution to the literature of projection. It expounds in simple language the principles of stereoscopic vision and describes the patient work of many years spent by the author and his father in research on the subject. And last, but not least, it presents several methods by means of which true stereoscopic effect may be obtained.

The outstanding fact with respect to these methods is that while they are of great importance in the development of the science, none of them is esthetically satisfying and all of them are commercially impracticable. This is of special significance within the hearing of those faint and disturbing cries of "stereoscopic projection" which come to us ever and anon from over the horizon.

Dr. Ives' paper should serve to silence for some time to come those who advance the claim of three dimension projection without an adequate understanding of what the words really signify.

¶ *The Standard Aperture*

NOW that the tumult and the shouting has died away, it appears that something has really been accomplished regarding standardization of camera and projector apertures—at least, they have been standardized.

Whether the new dimensions will meet with general approval, remains to be seen. There is nothing like practice to determine the feasibility of a theory.

It would appear, in view of the fact that certain hardy souls have agreed to agree, that congratulations are in order. They are freely offered.

For the information of those of our readers who are not yet acquainted with the details concerning the changes which will be necessary at the projector and at the screen before running the new releases, directions are given on one of our foregoing pages.

¶ *The Convention Season*

BY the middle of this month the Spring Meeting of the Society of Motion Picture Engineers, with its interesting program of papers, will have run its course. The next event of signal import in the scheme of things projection is the Thirty-first Bi-Annual Convention of the International Alliance, which is scheduled to take place in Columbus, Ohio, from June 6 to 11.

Present indications are that preparations are going forward with record speed. According to a recent report from headquarters, Mr. Fred J. Dempsey, secretary-treasurer of the Alliance, has already approved general plans for the convention as submitted by a committee of seven members from Columbus.

That the Alliance is well able to hold its own, despite the *Sturm und Drang* of present-day economic conditions, is indicated by the fact that all business sessions are to be held at Memorial Hall, an auditorium with facilities for seating some five thousand people . . . an enviable accomplishment for any society in this day of grace.

As a suggested slogan for this coming event, one is constrained to offer the obvious, "On to Columbus!"

CHARLES E. BROWNELL.

Motion Picture Film in the Making

By Franklin Courtney Ellis

When we think of Romance, we inevitably associate it with the Past . . . the fleets of Tyre with their precious cargoes of ivory, apes and peacocks . . . rakish Roman galleys plying the Blue Mediterranean . . . the gold-laden caravels of the Spanish Main. But behind the fleets of Tyre, of Rome and of Spain lay the driving force of Commerce, and that which may appear to be the unremitting, humdrum toil of the present day, may well be the Romance of tomorrow. In the article which follows, Mr. Ellis, himself associated with the Eastman Kodak Company, tells us the story of the manufacture of Motion Picture Film . . . a story which in its fascinating interest might justly be styled The Romance of a Modern Industry.—The Editor.

Part I

IN sunny Southern fields "darkies" sing as they pick cotton. . . . Steamers chop through the long ocean miles bringing saltpeter from Chile. . . . Sulphur comes to the surface in Texas. . . . Japanese with broad straw roof hats prepare camphor for shipment in Formosa. . . . Lumbermen harvest mighty trees, and alcohol is distilled from the waste wood that is too small for lumber. . . . Participants in a successful theater industry dine on roast beef while the hides from the beef are only beginning their industrial career. . . . Mexico, land of the conquistadors, yields the silver that valor dared for. . . . Methodical extractors derive potassium bromide from Great Lakes brine deposits. . . . A flash in the witches' cauldron of the photographic industry and film is produced.

Modern Alchemists

But the witches who conjure up several hundred thousand miles of magical ribbon every year wear no conical caps nor ride broomsticks.

Part of a Week's Silver Supply.

Entrance to Kodak Park, Typical Film Manufactory of the Article.

Change the picture to patient, alert engineers, skilled by long training in meeting rigid standards of accuracy; veteran emulsion chemists whose technique enables them to offer their market 100 different types of film; research men who hold their jobs because they are able to know what the photographic public is going to want several years later and have it ready. No less capable combination of men could conduct an industry in which delicate laboratory operations have been magnified to huge mass production proportions, and conduct it so that the product is satisfactory and uniform.

Let's, as a party of men who make their livelihood using film, visit a plant where film is made—not by any means a hypothetical manufactory, but an entirely real group of more than 75 major buildings standing on 400 acres and manned by a force of 6,500 persons imbued with an equally real tradition of making and meeting the "raw stock" standards of the motion picture industry and the nation's photographers, day in and day out.

Through the Gates

Entering from the busy highway, we find the grime and noise usually associated with manufacturing strangely missing. Here, instead, is a calm setting of stately elms, shrubbery, tidy lawns and ivy-clad buildings.

Scanning the figures for size, we shall realize that the industry confronting us is large in scale; but, in that, it is not distinctive from other huge enterprises—from an automobile factory, say, or a locomotive plant.

This film manufactory is different, however, from any other industry in the fact that the scale of operations, the expense, the large personnel, all are concerned in an unrelenting fight against seemingly inoffensive enemies —a speck of dirt too small to be seen, a slight variation of temperature, a dim ray of light entering where it does not belong.

In subsequent instalments we may have an opportunity to examine in detail some of the elaborate, unending precautions taken in the permanent drive against these enemies. For the present, let's simply pass quickly through our typical film manufactory for a quick survey.

The First Line Defense

Trees and lawns fronting this film plant exist only in part to beautify the grounds. A barrier against dirt is the more important purpose. The six miles of street within the plant are paved, and are constantly sprinkled, to guard not against dust that is unpleasant but against dust that endangers perfect pictures. The chimneys that carry fumes and cinders 366 feet into the air, the fireless steam locomotives, the fleet of electric trucks, the constant use of scrubbing machines and floor waxing machines, the white laundered suits worn in any building where film is uncovered, the employment of full-time cleaning crews, are not merely interesting innovations. They are part of a grim program that keeps this film plant perhaps the cleanest industrial area on earth.

We are using the term "film plant." It is not even necessary for this party of visiting motion picture projectionists to remember that a variety of photographic products is made here, since 35-mm. film for the motion picture industry is the object of their interest. Film for millions of snapshot cameras, nevertheless, is an exceedingly important product, comparable to motion picture film. It was a piece of amateur camera film from here that Edison had received when he said to his associates building a motion picture camera: "That's it. We've got it. Now work like hell."

Home movies—personal motion pictures—sprang from here and now form the equivalent of a large industry in themselves. Portrait and commercial photographers must be supplied, not with one type of film and paper, but with scores, to meet the various exacting needs of their work. Medical and dental radiologists diagnosing the infirmities of human anatomies, X-ray technicians examining the soundness of metals, of building materials, and of aeroplane parts, use a huge annual acreage of their recording medium.

Photo-engravers, bankers, astronomers, aviators, draftsmen, detectives, microscopists—a great variety of professions and activities have need for the photo-sensitive materials that this plant supplies. American consumption of photographic paper alone amounts perhaps to 4,500 acres annually.

Let our party take one of the passenger buses which depart every quarter-hour on routes that carry those with business, and may carry us as visitors, to the various factories and offices of this expansive area. The buses are a necessity, for there is a mile and a half of distance from the entrance gate to the remote buildings of the many that fit into the scheme of this city of well-seasoned brick and ivy.

In the "City" Streets

Through streets flanked by high-walled buildings, our bus travels, passing wheeled and pedestrian traffic; but the trucks move more silently and the pedestrians walk more briskly than the traffic of a less purposeful city.

On one side we see a six-story structure, a block long, which we are told is built over a reservoir that holds 5,000,000 gallons of water and that is emptied and refilled three times every day the plant is in full operation.

Down one street we observe a solid masonry wall with no window breaking its expanse. Behind it, we are informed, great white machines with many precise moving parts are turning in dim light or none, coating the transparent, flexible film base with the emulsion.

Along another thoroughfare flanked by ivy-covered walls we catch a glimpse of an imposing structure which overlooks the entrance to our typical plant. This, our guide answers, is the research center—in truth a research university in the sphere of photographic science. From here has come knowledge enabling continual advances in the quality and performance of photographic materials, some heralded, some made without public notice. Here, too, have been discovered many hidden complexities of photographic sensitivity; and here, as well, numerous patient studies have been made that have given photography and the motion picture art a scope undreamed of when they first came into being.

Silver of the Mine

There, on our right, is a building in which silver, by modern alchemy, is turning into materials far more precious to this civilized era—including motion picture film to entertain every week a large portion of the population of the United States.

It is a temptation to spend too much time seeing what happens to the silver. More than four tons of it are used every week. That is fascinating because it sounds fabulous. More interesting to technicians are the methods of converting silver purer than that which the mint buys into perfectly pure silver nitrate, ready for emulsion making; but we must leave closer inspection for a later instalment, even though the production and testing methods involved are quite typical of the whole film-making operation.

The film support or base—here again only a quick glance at the process—is composed of cotton which has been treated with a mixture of nitric and sulphuric acids to render it soluble in a mixture of solvents, the chief of which is methanol (wood alcohol). The "dope" obtained by dissolving nitrated cotton, having the consistency of honey, is spread on the polished rim surfaces of great wheels that run continuously, night and day, month after month. Heat around the giant wheels drives the solvents from the "dope" and permits the nitrated cotton to assume the form of a thin transparent layer on the surface of the wheels. After various convolutions within a machine, a wide strip of finished film base emerges and is wound up in rolls like newsprint paper.

Collateral Steps

Let's examine for a moment the steps that must be taken, collateral with the manufacturing process so briefly outlined, to insure the quality of the resulting film support. Let it be remembered that a microscopic speck of dust embedded in the material might be the nucleus of a spot causing a freckle on the nose of an immaculate cinema actress, a sharp crackle in the midst of a sound-film love scene, an extra star in some astronomer's Pleiades — or might spoil a snapshot of a child in some particularly entrancing pose.

Unusual climatic conditions might bring deterioration of valuable films if such exigencies were not provided for in manufacture.

Purity and precision are imperative in every operation and handling during film manufacture.

Samples of all cotton coming into the plant are tested before use. Three potential variables are thus governed. . . . Cotton, before being dumped into the nitrating machines, is accurately weighed. Variables of the nitrating acid, in addition to its temperature and amount, need to be controlled—and tests accomplish this. . . . Nitrated cotton, immersed in water, flows only through tile pipelines, to avoid contact with metal. . . . In the purification and storage building to which the flow is conveyed under a street and under a railroad track, the tanks are made of material inert to the ravaging action of acids so that no impurities may be introduced at that point.

Various Ingredients

The substance inelegantly called "dope", after the nitrated cotton has been thoroughly dissolved by its solvents, actually is the direct culmination in chemical purity of the careful work of hundreds of chemists and skilled workmen; and the result of study and improvement by two generations of engineers and research scientists. The physical condition of the material, as distinguished from the chemical, becomes evident when one sees the resulting sheets of film base winding through the great machines, so flawless and transparent as to be practically invisible.

Gelatine is used in large aggregate

(*Continued on page* 32)

A Battery of Machines Converting Fluid "Dope" Into Endless Sheets of the Familiar Transparent Flexible Film Base. . . . Almost Invisible as It Passes Over the Brightly Polished Rolls That May Be Seen Through the Heavy Plate Glass Windows.

A New Amplifier Output Tube

By A. ERNEST LYLE

In view of the widespread interest which has been accorded the recent introduction of the Speed "Triple-Twin Tube," the MOTION PICTURE PROJECTIONIST *is particularly fortunate in being able to present the following article on the subject from the pen of Mr. A. Ernest Lyle, Chief Engineer of the Cable Radio Tube Company, manufacturers of this new departure in tube design.* — THE EDITOR.

CONTEMPORARY developments in the art of sound reproduction, together with present-day economic conditions, have necessitated a complete revision of ideas concerning the magnitude of audio power necessary for satisfactory theatre and auditorium sound.

The high values of power initially used have been continually and sharply reduced. Theatres formerly using audio outputs of hundreds of watts and from twelve to eighteen speakers now find equal or superior coverage possible with one or two directional reproducers requiring approximately 10 to 15 watts of audio energy. Where special acoustical conditions have necessitated additional speakers for coverage of difficult locations, these are being satisfactorily supplied from another small 10 to 15 watt amplifier. In general these amplifiers derive their output power from the use of type 250 tubes operating in push-pull.

The object of this paper is to describe a new amplifier tube of greatly increased efficiency, the Speed "Triple-Twin" tube, with particular reference to its application in the theatre and public address field.

Introduction

The "Triple-Twin" is a new output tube capable of delivering high audio powers from relatively low input signal. It is at present available in three types. Type 291 designed for d.c. amplifiers, where the total available voltage is limited to that of the d.c. 120-volt line; Type 293 for automobile use where economy of power consumption is a prime requisite; and the 295 for general amplifiers utilizing a.c. as their power source.

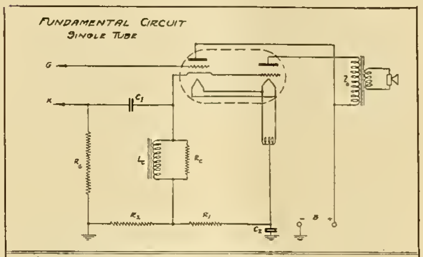


Fig. 1. (Upper) Single-Tube Circuit

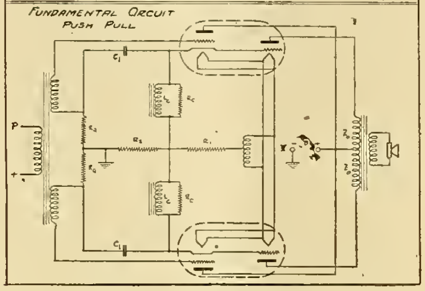


Fig. 2. (Lower) Push-Pull Circuit

The Type 295 "Triple-Twin" only will be considered here. This "Triple-Twin" tube operates at a plate potential of 250 volts and delivers in excess of 4.5 watts undistorted power for an applied grid signal of 5 volts R.M.S. Even this rating is very conservative, as 6 watts may readily be obtained without the introduction of objectionable harmonic distortion. (Fig. 3). For commercial sound work, however, the push-pull application will generally be indicated. Two "Triple-Twin" 295 tubes operated in this manner, and at 250-volt plate potential, are capable of delivering 14 watts of undistorted power for an applied grid signal of 7.5 volts R.M.S. The characteristics of the Speed Type 295 tube are shown in Table I.

The "Triple Twin" tube consists essentially of two sets of three elements each, directly coupled within the glass envelope. The first set of elements constitutes a driver section whose purpose is to present at all times a high impedance to the incoming signal and to maintain the plate characteristics necessary to supply power as required by the output grid. This section employs an indirectly heated cathode which is directly connected to the grid of the output section. This indirectly heated cathode electrically isolates the input emitter from the output filament. The second set of elements constitutes a driven section in which the grid operates essentially at zero potential swinging equally into the positive and negative portion of its grid-voltage, plate-current characteristics.

Efficiency of Tube

The efficiency of an output tube is customarily considered as the ratio of its a.c. power output to the d.c. power input. Amplifier tubes for receiving purposes are normally operated at a high value of negative grid bias, and input signal swings are so restricted that their positive peaks do not extend out of the biased portion of the grid-voltage plate-current characteristics as this would cause grid current flow with consequent serious harmonic distortion.

However, for a given power output the anode voltage necessary to overcome the field of the negatively biased grid and to produce that output must be considerably higher than would be necessary to produce the same power output from a tube whose grid was not negatively biased. Thus the "Triple-Twin" tube operating at zero grid bias and accommodating both positive and negative grid swings achieves a notable increase in efficiency. This efficiency is still further enhanced by the fact that this tube attains its maximum power output and minimum distortion for the approximate same value of load impedance and thus is able to operate into a load nearly equal to its own impedance rather than double this value, as is common practice in triode operation.

In analyzing the overall efficiency of an amplifier tube it is, of course, not sufficient to compare only the ratios of power output and power input, as these give no indication of the sensitivity of the tube. Where the sensitivity of one tube is sufficient to allow the elimination of one or more stages, then the effective efficiency naturally becomes much greater.

Table II compares the Speed "Triple-Twin" tube with two popular tubes of its own class having similar

Table 1: Triple-Twin Tube Characteristics

OUTPUT TUBE			
Heater Potential	*Volts*	2.5	
Heater Current	*Amperes*	4.0	
AMPLIFIER		*Input Section*	*Output Section*
Plate Potential	*Volts*	250	250
Grid Potential	*Volts*	—14.0	—3.0
Plate Current	*M. A.*	4.0	52.0
Plate Impedance	*Ohms*	12,000	3,000
Amplification Factor		14.4	13.0
Mutual Conductance	*Micromhos*	1,200	4,350
Load Impedance	*Ohms*	12,500	4,000
Undistorted Power Output	*Watts*	..	4.5
Grid Signal (for full power)	*Volts RMS*	5.0	..

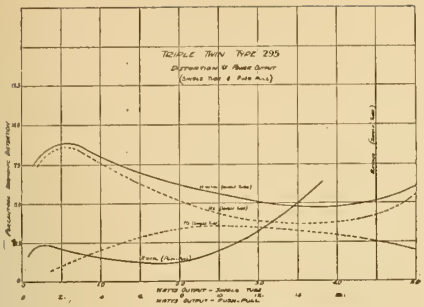


Fig. 3. *Curve Showing Distortion vs. Power Output*

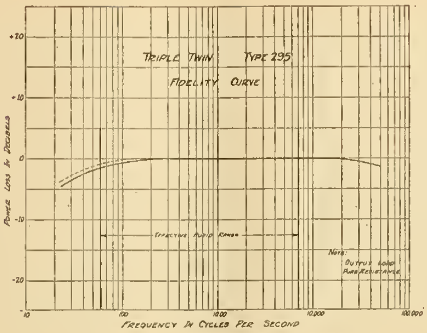


Fig. 4. *Fidelity Curve*

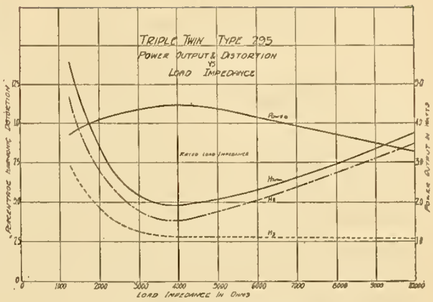


Fig. 5. *Power Output Distortion vs. Load Impedance*

plate voltage rating. The type 250 tube, while of a different voltage rating, is also included in this comparison because of its wide use in sound equipment. The efficiency of the tube is shown as the ratio of a.c. power output to the d.c. power input. As most applications employ self-biasing, the power dissipated in the bias resistor should properly be regarded as part of the power input and so the product of total voltages, i.e., plate voltage plus grid voltage, and total currents, i.e., plate current plus screen current, is used for the power input.

This table is self-explanatory, but particular note should be taken of the efficiency, which for the "Triple-Twin" 295 is almost double that for the Triodes 245, 250; and of power sensitivity, which for the "Triple-Twin" is approximately 10 times that of the Triodes considered.

Fundamental Circuit

The Fundamental "Triple-Twin" circuit is simple, as may be seen from Fig. 1. The input to the first section is similar to usual operation as this grid is maintained negative at all times and hence does not draw current, but it differs in that the cathode is maintained above ground potential, which means that the applied signal voltage must likewise be above ground potential. The signal reaches the cathode through condenser C_1 which offers a low impedance to the incoming signal. The grid receives its bias from the d.c. drop in the load impedance (Lc) of the first section and the IR drop in resistance R_2. The d.c. return path to this grid is through resistance Rg. It should be noted that the load impedance of the first section exists between cathode and ground and is substantially the combined parallel value of resistance Rc and the grid impedance of the second section. The inductance Lc is shunted across this combination but, except at extremely low frequencies, its impedance is high compared with the load and its effect on the load is negligible. It provides, however, a low d.c. resistance path for grid and plate returns. The drop across Lc due to its d.c. component also augments the voltage drop in R_2 and opposes the drop in R_1, but as the resistance of its winding is small this effect is negligible. Resistance R_1 establishes the grid of the output section several volts negative and is necessary only in a.c. operation to suppress hum. Condenser C_2 by-passes the audio-frequency in these resistors, preventing intercoupling between plate and grid. The plate circuit of the second section is identical to triode operation.

Theory of Tube

The operation of the "Triple-Twin" Tube is not difficult to understand, although it differs considerably from the usual triode action. It will be only summarized here as it has already been thoroughly covered elsewhere.*

Referring to Fig. 1 it will be seen that a signal applied across the grid-cathode of the input section is amplified and develops a potential across the load Rc and thus across the grid-filament of the output section. This amplified signal swings the output grid alternately, positive and negative in accordance with the alternations of the impressed signal.

During the negative alternations the output grid presents an infinite impedance but during the positive alternations it presents a continuously varying finite impedance whose value is a function of the varying instantaneous voltages developed across the load Rc. This means, of course, that a varying load is applied to the output of the first section. To compensate for the effect of this varying load the plate characteristics of this section are so designed that a change in the load will cause a corresponding change in its plate impedance of a magnitude just sufficient to offset the effect of the change in load.

It is easily demonstrated that this change in plate impedance of the input section varies automatically with the magnitude of grid current required by the output grid and thus the "Triple-Twin" is not a matched device but rather a self-compensating one. In practical application the compensation can diverge considerably from ideal conditions without appreciable effect on overall results.

Output and Load

The output of the "Triple-Twin" is comparable to that of usual triodes except that its load impedance may more nearly match the tube's plate impedance than with usual triodes. This means, of course, a more nearly ideal transfer of power and is made possible by the fact that the output grid swing is both positive and negative.

The design of the output section has been so arranged that the curvature of the plate characteristic with negative grid swings is similar but opposite in direction to the curvature of this characteristic during positive grid swings. Thus variations in wave shape introduced on the negative signal alternations are canceled by similar variations introduced on the positive alternation. Therefore, the proper load for minimum harmonic distortion may be made equal to the internal impedance, which condition also permits maximum energy transfer. Amplitude distortion resulting from characteristics of the type is

(*Continued on page* 30)

Table II: Comparison of Tubes

Type	Ep	Total Drain (Ep+Eg) x	 (Ip+Isg)	Po	Ro/rp	% Efficiency Po/Pi	Sensitivity $Ps=\frac{\sqrt{Po}}{eg\ (rms)}$
Triple-Twin 295	250	267	56	4.5	1.33	30	.42
Pentode 247	250	266.5	39.5	2.5	0.20	23.7	.15
Triode 245	250	300	34	1.6	1.95	15.7	.046
Triode 250	450	534	55	4.6	2.42	15.4	.035

---

*Stromeyer: *Triple Twin Tube*, I.R.E. paper, Pittsburgh Convention, April, 1932.

Projecting Motion Pictures in Relief

By HERBERT E. IVES †

Summary.—The essential conditions for producing pictures in stereoscopic relief are two: First, separate pictures must be made from different points of view, corresponding to the two eyes; second, each eye of the observer must receive its appropriate view. No compromise with these fundamental requirements appears possible.

If stereoscopic projection is to be achieved in such a form that a large group of observers may simultaneously see the projected picture in relief, the distribution of the appropriate views to the two eyes must be accomplished for each observer. There are two places where the distribution may be made: the first is at the observers' eyes; the second is at the screen on which the picture is projected.

Dr. Ives' lecture is reproduced through the courtesy of the S. M. P. E. Journal.

Part I

THE perception of relief in vision, that is, the location of different objects in the field of view at their proper relative distances from the eyes, is contributed to by a number of factors. We may list among these: geometrical perspective, according to which objects decrease in angular extent with the distance from the eyes; aerial perspective, by which distant objects are more or less veiled by intervening atmospheric haze; the effort of focusing or accommodating the eyes to objects at different distances; and, when the observer can move, by the different relative angular motion of near and distant objects. All these factors have been utilized to stimulate relief by makers of pictures both still and moving.

The most important factor, however, and the only one that needs discussion as a problem still awaiting practical solution is binocular vision, which is peculiar to man and certain of the higher animals, because of the location of the eyes side by side, both receiving images of the same objects. I shall, therefore, in this discussion, proceed at once to binocular or stereoscopic relief, and our problem will be to consider the ways and means by which motion pictures might be projected so as to exhibit relief of this character.

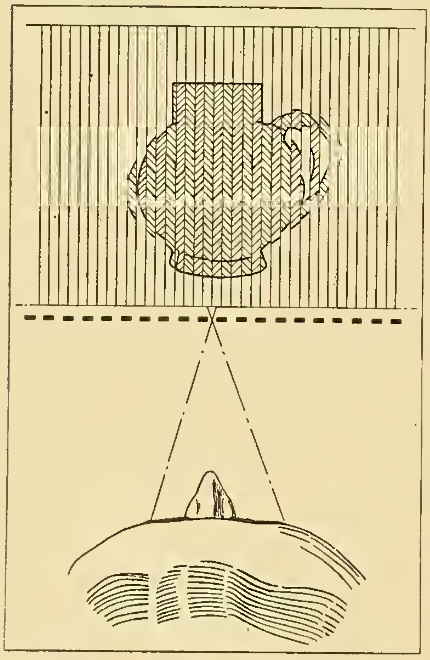


Fig. 1. The Principle of the Parallax Stereogram

Stereoscopic Relief

While the complete explanation of the process by which we appreciate relief when the two eyes receive images which are somewhat but not too different, in character, has not been worked out to the satisfaction of psychologists, the essential physical conditions of stereoscopic relief are simply stated. They are as follows: (1) Separate pictures must be available, made from different points of view, corresponding to the two views that are seen by the right and left eyes. (2) Each eye of the observer must receive its appropriate view.

These conditions are essential and inescapable. No compromise with them appears possible. No scheme which calls for a single picture or series of pictures taken from one point of view will meet the first requirement. No scheme which does not provide means for distributing the appropriate views to the two eyes will meet the second requirement. Once stated, these requirements appear obvious, and they have indeed been clearly understood by students of optics for approximately 100 years.

In spite of this, however, would-be inventors continue with surprising regularity to announce schemes for projection in relief which they claim require no special camera or form of picture, or, if they propose taking two pictures in order to meet the first requirement, evade the provision of means for separating these pictures in the process of viewing.

Having now cleared the ground, we are prepared for a straightforward discussion of our problem. For purposes of presentation, we may conveniently discuss it in three steps: The first step will be the production of relief pictures by processes which do not involve projection. The second step will take up relief pictures produced by projection processes, but in the form of "stills," that is, not embodying motion. The third step will be to consider the projection of relief pictures in motion.

Methods of Attaining Relief

In accordance with the requirements as stated above, the first piece of special apparatus which is needed in order to produce a picture in relief is some form of camera (we shall, of course, assume that the process of producing pictures is photographic), which can produce pictures from a number of points of view. In the simplest case, the number of points of view will be two, one for each eye, the apparatus consisting of a pair of similar cameras whose lenses may be separated by approximately the distance between the two eyes.

Pursuing this simplest method of making relief pictures, that is, simple stereoscopic pictures of the old and well-known form, we may now go over to the viewing end and consider means of meeting the second requirement: namely, the distribution of the two pictures to the appropriate two eyes. The simplest apparatus for viewing two pictures, one at each eye, consists of no apparatus at all, but lies in the proper directing of the two eyes.

Holding up a pair of stereoscopic prints in front of the eyes, with the right eye view at the right and the left eye view at the left, one can, by practice, learn to diverge the optic axes and see one picture with each eye; or, if the two pictures are mounted side by side, but in the reversed relative positions to those just considered, one can, by converging the optic axes to a point between the eyes and the pictures, again see one picture with each eye, and thus produce a picture in stereoscopic relief.

Viewing Device

Next in order of complexity of viewing device is some form of stereoscope. This may consist of mirrors or prisms placed one over each eye, and so directed or of such angle as to present one view to each eye, the eyes being in their normal unconverged or undiverged position. The stereoscope is an instrument very familiar to students of optics, and in a previous generation achieved wide popularity as a form of entertainment. In our present more feverish age, the appeal of pictures without action, even though possessing another aspect of naturalness, is so slight that it is now not unusual to find people who have never looked through a stereoscope.

---

†Bell Telephone Laboratories, New York, N.Y

Another means of distributing the pictures to the appropriate eyes is provided by utilizing color. In the anaglyph, the two elements of the stereoscopic pair are printed in complementary colors, and special spectacles are provided for the observer with a screen of different color for each eye, whereby only one picture is seen through either element of the spectacles.

The revolutionary idea that the distribution of the different views to the two eyes might be made, not at the eyes of the observer, but at the picture itself, was introduced by Frederic E. Ives about thirty years ago in the invention of the parallax stereogram. This device, since it is the direct ancestor of the most interesting projection methods which I shall describe, demands careful description and comprehension. According to requirement (1), as stated above, two pictures are taken, from two points of view.

Instead, however, of being mounted side by side as in the ordinary stereogram, these pictures are divided into very narrow strips, these strips being juxtaposed so that the left-hand strip of a pair is from the right eye view, and the right-hand strip from the left eye view. Close to this picture of alternate strips, which is in the form of a transparency, is mounted an opaque line grating with its clear spaces approximately half the width of its opaque spaces. This grating is mounted at such a distance in front of the stripped picture and in such relative lateral positioning of its lines that at a certain distance from the observer's face the right eye strips are entirely concealed from the left eye and the left eye strips are entirely concealed from the right eye.

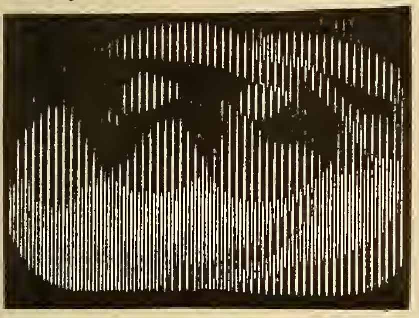


Fig. 2. Photomicrograph of Portion of Parallax Stereogram Showing Juxtaposed Strips

What the Eye Sees

Each eye then sees only a single view composed of a series of strips which, however, are made of such fineness (say, 100 to the inch) as to be invisible or unobjectionable at the viewing distance. This parallax stereogram, when held directly in front of the face, parallel to the two eyes and at the proper distance, exhibits stereoscopic relief without the interposition of any viewing device located at the observer's eyes. The principle of the parallax stereogram is illustrated in Fig. 1, and Fig. 2 is a photomicrograph of a small portion of an actual parallax stereogram transparency.

A limitation of the parallax stereogram is that it must be viewed from a single definite direction and distance. While this detracts but little from the appeal of the picture if only one observer is to be considered, it is a serious defect if, as must be the case when we come to discuss means for projecting pictures visible to an audience, a large number of people, variously placed, must observe the relief picture simultaneously. In order to achieve a relief picture which shall be visible at any distance from any direction of observation, it is necessary to break away from the idea that stereoscopic relief is essentially a matter of *two* images.

The Point of View

Consider that the picture is to be viewed not by one person in one position, but by any number of people in any possible positions. It is obvious at once that while each of these observers needs only two images to satisfy *his* two eyes, the total number of eyes to be satisfied may be very great. This demands at the taking end that some camera arrangement be adopted which will make the pictures from a very large number of points of view. At the receiving end it demands that the grating, or its equivalent, have relatively extremely narrow clear spaces so that, as an observer's eye takes up different angular positions, an entirely new composite view will be seen.

In short, in place of the two strips which are behind each grating of the stereogram, there must be an extremely large number of minute strips behind each very narrow grating opening, and since these strips are (in the horizontal direction) little panoramas, I have proposed the name of "parallax panoramagram" for this kind of picture which shall exhibit relief from any angle or direction of observation. The principle of the parallax panoramagram is illustrated in Fig. 3. Fig. 4 shows, greatly enlarged, a portion of a parallax panoramagram positive suitable for viewing through a grating with very narrow clear spaces.

It is evident that the problem of making parallax panoramagrams with their large number of points of view must inevitably call for bulky or complicated apparatus. Several methods have been proposed. The most obvious is to provide a battery of cameras, arranged, say, in an arc about the object, with their lenses in close juxtaposition. If these cameras are then subsequently used as projectors for the pictures made in them, and are all directed to a sensitive plate placed behind a grating having very narrow clear spaces, the resultant photographic print will, with its grating, constitute a parallax panoramagram.

In order to avoid the very large number of cameras and printing projectors required by this elementary scheme, the alternative has been proposed of using a motion picture camera which is moved about the object at a slow rate, while the requisite large number of views are taken in succession upon a motion picture film. Upon projecting the developed film from a projector similarly moved, on a sensitive plate behind a grating, a parallax panoramagram is obtained with considerable simplification of apparatus, but at the cost of the greater time required for the successive as contrasted with the simultaneous exposures of the first scheme.

Another method of making parallax panoramagram negatives consists once more of a moving camera, but uses a grating in front of the sensitive plate and develops the minute panoramas behind the grating as the camera is moved relatively to the object, either by moving the grating during exposure by the width of its spacing (a method due to C. W. Kanolt) or by separating the grating and plate, and depending on the sweeping of the beam of light through the grating slit across the plate behind it as the relative positions of lens, grating and plate are altered during the exposure. This method, like the one using a motion picture camera, requires a sufficient time for exposure for the camera to be moved through an arc or other suitable path about the object.

A third, optically ideally simple, method of making parallax panoramagram negatives consists in using a single very large diameter lens or concave mirror for providing the different points of view. This method requires that the lens or mirror subtend an angle from the object as large as it is desired that the final picture be visible in relief. For an angle of 60 degrees this requires that the lens or mirror have a diameter as great as the distance from which the object is photographed. Practically, in order to obtain such angles as this, a concave mirror is the only feasible device.

An arrangement which has been

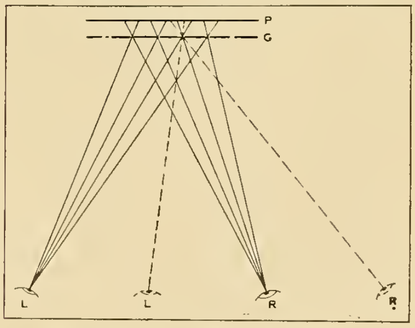


Fig. 3. The Principle of the Parallax Panoramagram

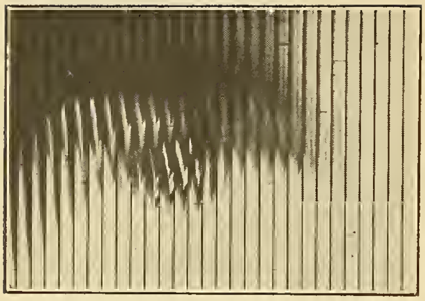


Fig. 4. Photomicrograph of Portion of Parallax Panoramagram Showing Panoramic Strips

used successfully for this purpose is shown in Fig. 5. It consists of a strip from a 4-foot diameter concave mirror, in front of which is placed a half-silvered plane mirror at 45 degrees. The light passing from the object to the concave mirror is reflected back to the 45-degree mirror and then downward to the sensitive plate, which is placed slightly behind a grating having clear spaces 1/50 the width of the opaque. Each element of the concave mirror sees the object from a different point of view, and reflects an image in a definite direction through the grating lines. By using this scheme, a parallax panoramagram negative may be made at a single exposure.

A certain price must be paid for such simplification, which is that the perspective relations are disturbed; infinitely distant objects are imaged at the focus of the mirror, which lies a relatively short distance behind the picture plane, thus restricting the method practically to objects near that plane. This restriction is, however, already present in any practical parallax panoramagram since the definition in the panoramic strips necessary to differentiate clearly objects far away from the picture plane is much beyond that possible by the "pinhole" action of the grating spaces.

Still Relief Pictures

Before going on to the question of projection, a few points with regard to still relief pictures of the parallax panoramagram type may be noted. As above described, the pictures are transparencies viewed through an opaque line grating. The form of grating described with its extremely narrow clear spaces is quite wasteful of light. In its place may be substituted a grating composed of convex ridges of such curvature as accurately to focus parallel rays on the panoramic strips.

In order to realize the full advantages of such convex ridges, however, it is necessary that the strip picture be printed, not on a flat surface, but on a series of surfaces which are concave with respect to the ridges already considered. This means that the parallax panoramagram should consist of a sheet provided with front and back convex ridges, each of different curvatures, as shown in Fig. 6. The curvatures for this purpose are easily computed, and if the technical difficulties of preparation are overcome, will provide parallax panoramagrams which are not wasteful of light, and in which the panoramagrams are visible equally well from all directions of observation.

Another point to be mentioned in passing is that while only transparencies have been considered, the form of picture just described with its ridged structure may be made up as a picture for viewing by reflected light, provided the photographic emulsion be backed by some white reflecting material, the picture being printed, of course, to low density. Light incident on this doubly ridged structure can only come off from any given narrow element of a panoramic strip in a certain definite direction, thus meeting the essential conditions.

A Further Point

One further point must be touched upon as presenting an ever-present technical problem. In making pictures for the ordinary stereoscope, the photographic lenses, of course, invert each element of the stereoscopic pair. It is accordingly necessary when stereoscopic pictures are made on a single plate, that the prints be cut in two, and each separately inverted. If this be not done, the pictures will exhibit in the stereoscope, not stereoscopic, but pseudoscopic relief, that is, solid objects sink in instead of stand out.

Now, in the preparation of parallax stereograms and panoramagrams are involved similar inverting operations which must be done by some optical inverting device. As an illustration, the pictures made by means of a large lens or mirror show pseudoscopic relief if the picture is viewed through the grating. In order to obtain stereoscopic relief, the expedient is adopted in this case of viewing the grating through the picture. In every form of taking and viewing device used for parallax panoramagrams, a close watch must be kept in the inversions due to the optical elements, and means must be adopted for assuring that the relief is stereoscopic instead of pseudoscopic.

Taking up now the problem of projecting pictures in relief, the logical order is first to study projection of still pictures, leaving until the end a discussion of the peculiar difficulties introduced by motion. In general, all the methods which we have discussed for producing relief pictures are available, with certain modifications for projection. The essential feature of projection is, of course, that in place of a picture fixed in the plane which is observed, the actual picture used is placed in a lantern or other projecting device, and an image, usually enlarged, is thrown upon the observing plane, which for convenience may be spoken of as the screen.

Following the same outline as that used in the previous section, we note, first of all, that the simplest method of projecting pictures in relief is to throw upon the screen the two elements of a stereoscopic pair, and to look at them directly without interposing an optical instrument, diverging or converging the optic axes so that each eye appreciates only one picture.

Projection in Relief

All that is necessary, therefore, to achieve projection in relief is to project pairs of pictures, and to train our audiences to control their optic axes by making themselves temporarily cross-eyed, or the reverse, during the projection period. While this method of stereoscopic projection is entirely feasible for an audience of optical experts who have had a little training and practice, it does not appear promising for popular use.

Proceeding next to apparatus to be placed before the eyes of each observer, we note that each person in the audience may wear the equivalent of a stereoscope of either the mirror or prism form. Next in order is the anaglyph scheme, in which the two pictures are projected in different colors, and each member of the audience wears colored spectacles. This scheme has been used with success in

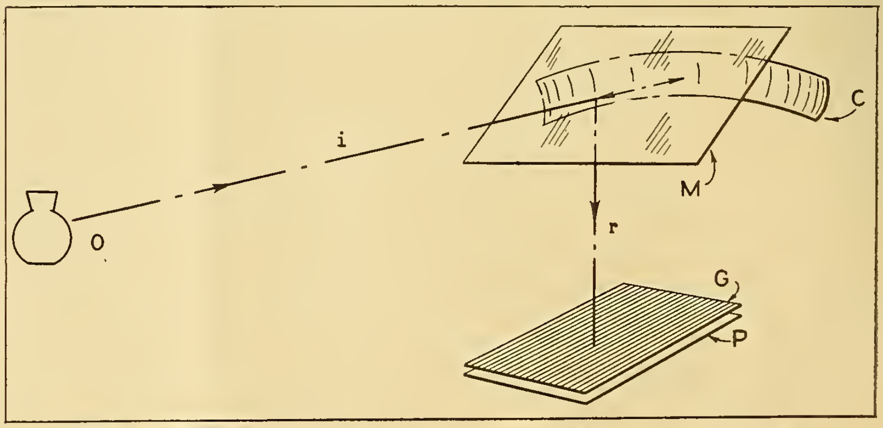


Fig. 5. *Method of Using a Large Concave Mirror for Making Parallax Panoramagrams*

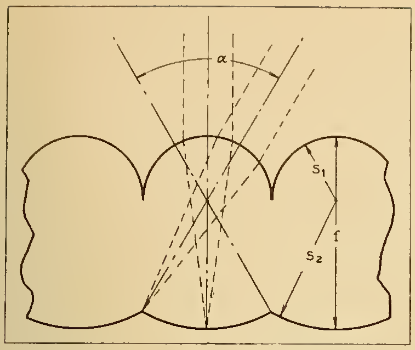


Fig. 6. Section of Parallax Panoramagram Structure

numerous demonstrations; it suffers from the limitation that it is not applicable to projection in natural colors.

Two Other Schemes

Two other schemes, which might conceivably be used for non-projected pictures, are nevertheless specially feasible with projection and are to be ranked among the practical methods of this sort. These are, respectively, projection of the two images with polarized light, and projection of the two images in quick alternation. In the first of these methods, the two images are projected by two projectors, one with light polarized, say in the horizontal plane; and the other with light polarized in the vertical plane. Each observer is then provided with a pair of polarizing prisms, the prisms being mounted in front of the eyes, one vertical and the other horizontal, with respect to its plane of polarization.

By this means, perfect separation of the two images is obtained. In the alternate projection method, the two images are thrown on the screen alternately in such rapid succession that they appear continuous by persistence of vision. In front of each observer's eyes are then placed shutters which expose the two eyes alternately, operated in such phase that each eye sees its appropriate image as projected. This method of relief picture projection has been successfully demonstrated to a full theater audience.

Inconvenient and Expensive

These methods of relief projection, which call for separate viewing apparatus for each member of the audience, are, optically speaking, simple and reasonably satisfactory, and are easily adapted to motion pictures. However, the goal of speculation in relief picture projection has always been some means of achieving relief without subjecting the observers to the inconvenience of special individual spectacles or the picture producer to the expense of the multiple viewing apparatus demanded. While it is at present doubtful whether schemes which provide the distribution of images to the different observers at the screen can approach, in simplicity and feasibility, these methods which divide the images at the eyes, they are of great optical interest, and I shall proceed forthwith to a discussion of them.

In discussing projection schemes of this general type, I shall adopt an order of presentation which is not perhaps logical, but which ties in most closely with the results of our study of non-projected relief pictures. I shall proceed at once to the problem of projecting parallax panoramagrams in their most fully developed form.

Let us imagine that instead of putting behind the opaque line grating a transparency print from a parallax panoramagram negative (made with its panoramic strips properly oriented to be placed behind the grating), we put a translucent screen, and that we remove our parallax panoramagram print to a projection lantern placed at an appropriate distance behind the grating and screen; we then project this parallax panoramagram print upon the screen in exquisite focus and in accurate registration as to size, position, and inclination of the panoramic strips behind the slits of the grating. If this operation can be performed with the requisite accuracy, an observer stationed anywhere in front of the grating will see a relief picture which will be indistinguishable from the ordinary parallax panoramagram.

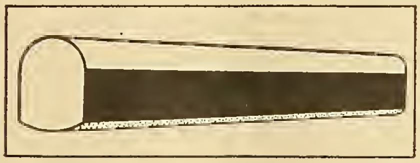


Fig. 7. View of Glass or Celluloid Rod for Translucent Screen

The opaque line grating which we have assumed will, of course, be very wasteful of light, and in its place it is preferable to use a ridged structure such as has already been discussed. In the case of projection we are, of course, interested in much larger pictures than, for instance, in show window transparencies. In a screen several feet across containing 200 or 300 ridges, the individual ridges may be as large as a quarter-inch in diameter.

This relatively large size makes it feasible to consider building up the screen of separate rods of transparent material, such as glass or celluloid. These rods will have a cross-section consisting of two flat sides, a front surface of one radius of curvature, and a back surface of another radius of curvature such that all points of the real surface are in the sharp focus of the lens formed by the front surface and the body of the rod. This rear surface must then be given a frosted or other diffusing finish.

When a large number of these rods are clamped together they form a screen of the desired type, on the back of which the parallax panoramagram print can be projected. A single rod for such a screen is shown in Fig. 7. An experimental screen, built up of 200 rods, of this form is shown in Fig. 8, together with the projection lantern used in an experimental demonstration of relief projection by this method.

Postponing for the present a discussion of how the slide containing the several hundred panoramic strip images is to be made, we can discuss the practical difficulties which must be faced in projection of this sort. Assuming that the picture to be projected is of ordinary lantern slide size and that the picture is to be divided into 500 narrow panoramic strips, which would correspond to a screen 10 feet across with ¼-inch rod elements, we must have on our lantern slide something like 150 panoramic strips per inch.

Difficulties Involved

Each one of these strips must be a complete little panorama containing enough sharply defined elements to provide separate images for each pair of eyes in an audience spread out through at least 60-degrees angular position in front of the screen. As a working figure, if we assume 100 differentiable strip elements in each panoramic strip (this corresponds to a separate view for each eye 20 feet from the screen, lying within 10 feet from the center line of the auditorium), we must have a lantern slide in which the resolving power is of the order of magnitude of 1/15,000 of an inch, approximating a wavelength of visible light.

Proceeding now to the projection lens, this must, of course, give an accurately rectilinear image, in order that the panoramic strips on the slide may be accurately positioned on the back of the projection screen. Next, the defining power of this lens must be such that it images the panoramic strips on the backs of the screen rods with exquisite fidelity. Proceeding

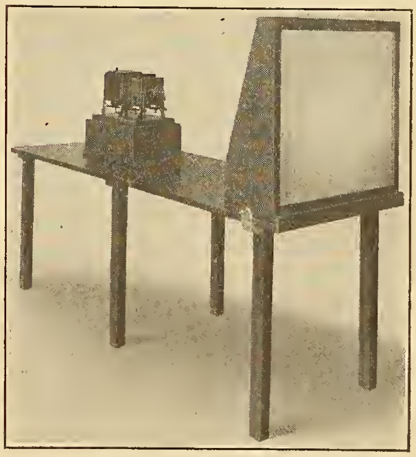


Fig. 8. Experimental Arrangement for Relief Projection

now to the rod screen, it is obvious that the individual rods must be figured with an accuracy comparable with that found in good optical lens work if line elements of approximately one-hundredth the width of the rod are to be focused from the back diffusing surface into parallel beams to be passed into the observing space.

It may be mentioned in passing that in place of the transmission screen which has been discussed, forms of reflecting screen are also possible in which concave or convex cylindrical rods are used. In every case, however, the requirements as to extraordinary perfection of all the optical parts obtain.

From this rough discussion of the requirements, it is obvious that the projection of a parallax panoramagram by this method calls for most extraordinary refinement of all the elements concerned. On a crude scale, however, it has been found by experiment that the procedure can be carried through, and relief projection has been accomplished experimentally in this way.

Lantern Slides

Taking up now the problem of how to produce the "lantern slides" for projection by this method, it may be said in general that any of the methods which have been described, such as those employing multiple lenses, moving lenses, and so on, may be used. However, looking ahead toward a procedure which might be applicable to motion pictures, the most desirable method would be one in which the pictures are made by a single exposure on a single plate. The one method which is now available for this is to use a large concave mirror as already described.

When it comes to making pictures for projection, however, a complication is introduced, which is, briefly, that the mirror method produces pictures which are too large for insertion into an ordinary projection lantern. Due to the physical impossibility of producing a lens or mirror which shall be both of such large size as to subtend a large angle with ordinary objects, and at the same time of such short focus as to produce images as small as a lantern slide, the mirror method is, generally speaking, only successful in making pictures of natural size.

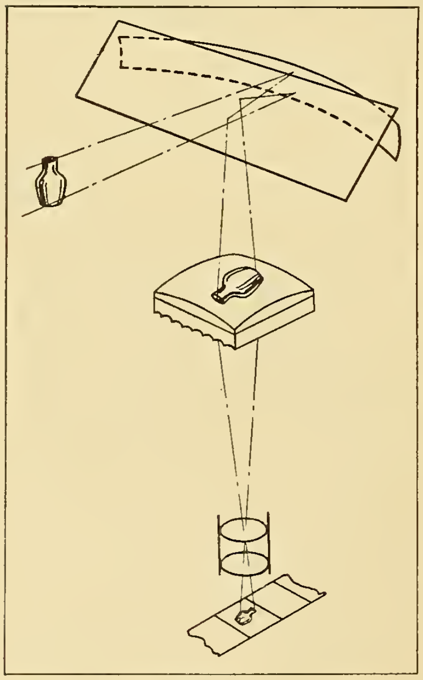


Fig. 9. Arrangement for Producing Negatives

Thus, for making portraits, a mirror having a radius of curvature of four feet, with the face and the sensitive plate each placed four feet from the mirror, is a practical arrangement. If larger or more distant objects are to be photographed, the size of the mirror must increase in proportion, as well as the size of the picture which is obtained.

Reduction Necessary

To overcome this difficulty, the parallax panoramagram negative made with a large mirror must be reduced in size, by some photographic procedure. The preferred way to do this is to re-photograph the strip images, formed behind the grating upon a diffusing glass, directly, in the first picture-taking operation. A more satisfactory method of obtaining the strip images is to substitute for the grating and diffusing glass a transparent ridged screen. The ridges, in order to assure that the final picture shall be stereoscopic instead of pseudoscopic, must be of the correct direction of curvature for the kind of projection screen which is to be used.

For a projection screen of the type we have been discussing, the screen in the camera should have concave cylindrical ridges, which form minute virtual panoramic images. When a photographic lens is placed behind this screen at the proper distance with respect to its focal length, as illustrated in Fig. 9, a second reduced image is formed which may be made of any desired size, such as that of a lantern slide. Prints made from this negative are then suitable for projection. It is again obvious that the optical quality of the concave ridged screen and of the photographic lens just described must be of extraordinary perfection. Also, that the photographic emulsion used must be of exceedingly high resolving power.

The system of relief projection which has just been described is, from the strictly scientific standpoint, bearing in mind its limitation to objects near the picture plane, a complete solution of the problem of projecting still pictures in relief.

Before going on to discuss the peculiar problems of motion picture projection, we may consider some suggestions for evading the severe requirements which the ideally complete method just described involves; in particular, the great practical difficulties of exact registration of the projected panoramic strips on the screen elements, and the necessity for extraordinary resolving power in the photographic emulsion. There are several ways of escaping from these requirements which, however, demand giving up the single projector or the single image.

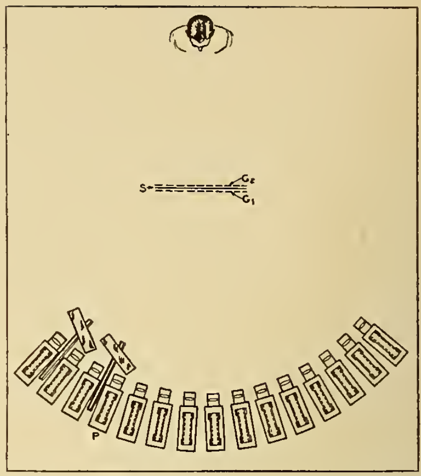


Fig. 10. Method of Projecting Using Large Number of Projectors

One method which has been experimentally demonstrated consists in projecting images from a battery of projectors. If, for instance, a translucent screen is mounted with an opaque line grating both in front of and in back of it, and a multiplicity of images is projected from different directions through the rear grating upon the translucent screen, the space in front of the screen will present relief pictures from any position or direction. (Fig. 10.) The registration of these multiple images upon the screen is a matter of relatively insignificant difficulty compared with the registration problem above considered. (*To be continued*)

Chicago Daily News RCA Photophone Licensee

The Chicago *Daily News* has become an RCA Photophone recording licensee and is arranging to install complete RCA Photophone recording equipment shortly, according to an announcement by the RCA Victor Company.

Preeminent in their several fields of activity as publishers of the Chicago *Daily News*, operators of radio station WMAQ, and world-wide producers of the Universal Newspaper Newsreel for Universal Pictures Corporation, the *Daily News* is expected to expand its motion picture activities into other fields.

The *Daily News* is licensed to produce films for commercial and newsreel purposes and has concluded a special arrangement with RCA Victor for reducing its 35 mm. film to 16 mm. size for the new RCA Photophone portable projector.

Sound Reproduction—Disc Pickups

Western Electric's 4-A Reproducer

By L. S. BENTON

In the ensuing article Mr. Benton of Electrical Research Products, Inc., describes the development of the disc pickup, beginning with a brief outline of its early history and carrying the story into a simple but informative discussion of the theory underlying the various types of the unit as now in use. The article concerns itself mainly with the construction and the operation of the Western Electric 4-A Reproducer.—THE EDITOR.

IN a district school reading book of forty years ago was a "piece" about the extreme cold encountered in far Northern latitudes. Among the unusual and interesting phenomena recounted was the effect of the cold upon speech. It was soberly related that at certain very low temperatures words became inaudible, freezing as fast as they fell from the lips of the speaker; so that if one wished to know what another was saying he must carry with him a broom and dust pan, sweep up the words as they fell, carry them to his igloo and thaw them out in a frying pan. This, no doubt, was one of the earliest sound reproducing systems on record.

While the story falls properly into the "believe-it-or-not" category, it illustrates the desire of man from earliest times to record the spoken word in such a way that it can be reproduced—not as writing, but as sound. "Sound," they used to tell us, is "any disturbance of the air whose vibrations can affect the ear." The definition is somewhat crude, but everybody knows what it means. So when the problem of reproducing sound was considered the first step was to capture those "disturbances of the air" and put them in storage, as the housewife cans fruit in summer and puts it down cellar for later use; the next step was to cause the canned sound to disturb the air again, just as the original sound had done.

Early Work

Those two steps—the *recording* and *reproducing* of sound—were, to be more or less ungrammatical, some problem. No one knows who first began the quest, or how many inventors spent time, money and effort in the search. Success finally came, however, and in 1877 Edison brought out his first successful talking machine.

History teaches that after the first fundamental principle of an invention has been established there follows a long period of improvement upon the original design before the next fundamental development takes place. So it was with the talking machine. The correct principle—a record made by a vibrating body causing a path to be traced in a plastic medium, and the reproduction of those vibrations by another body following the path cut by the first—gave us the first talking machine.

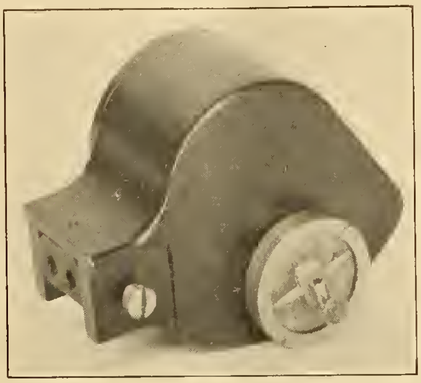


Fig. 1. The 4-A Reproducer

Then followed years of development; the wax cylinder record gave place to the disc; the material of the disc was made more durable; the needle underwent changes and the arrangements for recording were continuously improved; and gradually "his master's voice" became more and more recognizable. And although the sounds from those first machines were sometimes scarcely intelligible, yet to the shut-in dwellers of those horse-and-buggy days the records were indeed a godsend in relieving the monotony of long winter evenings.

Frequency Range

But still the records lacked a great deal. When an orchestra plays a symphony, or an artist sings an aria, or an orator delivers an address, the listener is not conscious of the individual sounds, for all that should be there are there, and the recollection left in the listener's mind is of the performance as a whole. But when the symphony or aria or oration was reproduced on a talking machine there was a difference. Many of the lower tones weren't there at all; some of the higher tones screeched and squeaked, and ever and anon came sounds from the machine for which neither the orchestra nor artist or orator was responsible.

So man continued his study of the problem, both of recording and of reproducing; and of the two, the former is probably the more important, for a sound record is somewhat like a bank balance—one can't draw out what one hasn't put in, at least not without unpleasant consequences. But progress along both lines was continuous and finally resulted in the production of instruments whose performances were quite comparable with the original sound, and our homes became filled with victrolas and graphophones and other types of machines, according to our taste or pocketbook or sales resistance.

But in spite of all efforts, the sounds were tinny and lacking in those qualities which make music and the human voice so delightful. Now for years it had been the business of the telephone industry to transmit the human voice from one point to another reliably and intelligibly. It was only natural, therefore, that from the telephone engineers should come the next improvement.

The way they set about the problem was simple and natural and reminds one of that old story of the man who was able to find those lost horses because he "thunk like a hoss." For the engineers, in attacking this mechanical problem, "thunk" like electrical engineers. They called the various mechanical factors by their electrical names; mechanical force became electrical voltage; mechanical velocity became electrical current; mechanical mass became electrical inductance, and so on. And thus the electrical recorder came into being.

Electrical Recording

The credit for the successful development of the electrical system of recording belongs to a group of telephone engineers at the Bell Telephone Laboratories, where an extensive research on the nature of speech was in progress. The system they devised may be briefly described thus: The sound waves impinge on a microphone of high quality, thereby producing electrical vibrations. These electrical vibrations are amplified by a vacuum tube amplifier, any distortion which may have been introduced being corrected by a device known as an "attenuation equalizer." These equalized electrical vibrations are converted into mechanical energy, by means of which a cutting stylus traces the sound groove in the soft wax of the revolving master record.

Not only was the sound recorded with far greater faithfulness by this method than had ever been possible before, but it was also possible now to record it at a distance from its source. This was a tremendous advantage, particularly in the recording of orchestral music. In the mechanical recording of an orchestral selection, for example, it had been necessary to

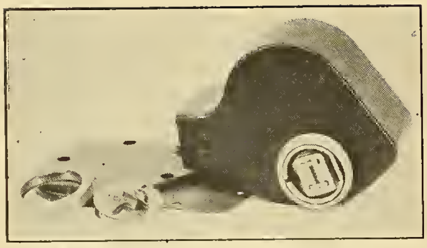


Fig. 2. 4-A Reproducer with Diaphragm Removed

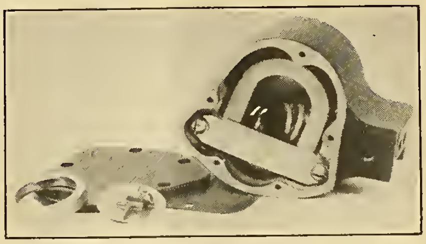


Fig. 3. Opposite Side, Showing Permanent Magnet

huddle the orchestra as closely as possible about the recording apparatus; with the electrical method, it was possible to arrange the orchestra as for a regular concert performance.

It was but natural that the engineers, in connection with their study of electrical sound recording, should also attack the problem of electrical sound reproduction, and this is exactly what took place, and with highly satisfactory results. However, electrical reproduction was at first considered of secondary importance and was intended at the time merely to assist in the major work of recording. But the success of electrical recording and reproduction almost instantly suggested the idea of associating them with moving pictures, and thus what was originally planned as a laboratory tool became a major industry.

The Electrical Reproducer

This brings us at last to the immediate subject of this article, the electrical reproducer, or, in the language of the projection engineer, the "pick-up"—the instrument in which the work of reproducing the sound originates. There are three general types of electrical pickup, classified according to the electrical factor chosen as the variable in developing the design: (1) the resistance variation (carbon microphone) type, (2) the capacity variation (condenser transmitter) type, and (3) the inductance variation (electrodynamic or electromagnetic) type.

Carbon microphones were tried out extensively in the earlier days and found wanting, being somewhat unstable and noisy for this type of work. While the noise feature is lacking in the condenser transmitter pickup, this type is nevertheless ruled out for reasons similar to those which disqualified the carbon microphone. The inductance variation type lends itself most readily to pickup work, both the electrodynamic and electromagnetic types having proven their commercial practicability.

Up to the present the electromagnetic type has been most generally used with lateral cut records, and in this type of pickup there has been a wide range of development. There are single-pole, two-pole, three-pole and four-pole systems; there are spring-suspended armatures, centrally pivoted armatures and needle armatures; and finally there are pressure damping and pressureless damping.

The theory of the electromagnetic pickup is simple. An armature or diaphragm attached to the phonograph needle is made part of a magnetic circuit which is surrounded by a coil of wire. As the needle follows the grooves of the record it moves the armature or diaphragm and so varies the amount of magnetic flux flowing in the magnetic circuit. This change in flux induces in the coil a voltage which is amplified and then sent out through the horn or loudspeaker.

The first commercially successful talking motion pictures in the world were shown to a skeptical audience in New York by Warner Brothers and Vitaphone Corporation on the evening of August 6, 1926. The pickup used at this presentation was the Western Electric Company's 2-A reproducer—an electromagnetic reproducer, rectangular in shape, designed to be mounted on a tone arm and used in connection with a turntable.

The reproducer unit consisted essentially of a permanent magnet with laminated pole pieces, and a needle holder which actuated an armature in the air gap between the pole pieces in such a manner as to produce, through electromagnetic induction, fluctuating electric currents corresponding to the speech or music on the record.

These fluctuating currents were carried through the amplifying system to the receiver of the horn or loudspeaker, and thus translated into sound. The apparatus worked well but was somewhat cumbersome and had the disadvantage that dirt or foreign matter, especially magnetic material, would get into the air gap and cause distortion, necessitating constant attention and frequent overhauling. Before long it gave way to the reproducer in general use today—the 4-A.

W.E. 4-A Reproducer

Examining the design of the 4-A reproducer, one cannot fail to be impressed by the amazing results obtainable from the most simple devices. Does it seem possible that the sounds you hear when sitting in a theatre are due to a small round diaphragm of clock-spring steel only three-thousandths of an inch thick and less than an inch (0.963", to be exact) in diameter? Yet that's exactly the case if you happen to be listening to a disc record being played with one of these instruments.

The engineering description of the 4-A reproducer sets forth that the instrument "consists essentially of a permanent magnet and needle holder which actuates an armature in such a manner as to produce fluctuating electric current corresponding to the speech or music on the phonograph record." The accompanying photographs and diagram will enable us to understand how it works.

Fig. 1 shows the reproducer; Fig. 2 is a view with the diaphragm and its clamping ring removed; Fig. 3 is a view of the opposite side of the reproducer, showing the permanent magnet and furnishing also an excellent view of the diaphragm. You will note that a fin, which is at right angles to the needle, runs nearly all the way across the face of the diaphragm at its center, and that the fin carries the needle holder. The socket into which the needle is inserted, and the hole for the clamping screw which holds the needle in place, are also clearly shown.

One pole piece of the permanent magnet is divided into two branches, each branch having wound around it a coil consisting of many turns of fine wire (the ends of the cores of these coils appear at top and bottom of the slot in Fig. 2). The other pole piece is circular in form and is the broken ring shown in Fig. 2 surrounding the divided pole piece. These various parts are indicated in Fig. 4, which is a line representation (schematic) of the instrument.

Pickup in Operation

When the turntable revolves, the needle, in following the groove of the record, moves sidewise in one direction or the other at right angles to the groove. Each minutest sidewise movement is communicated through the needle holder and fin to the diaphragm, causing the diaphragm to bend into an "S" shape, the fin acting as an axis about which the bending takes place. This bending brings the upper part of the diaphragm now nearer to, now farther from, one of the two arms of the divided pole piece; at the same time the lower part of the diaphragm moves in the opposite direction. This is clearly shown in Fig. 4.

When the needle E assumes the dotted position, the diaphragm D is bent into the reverse curve indicated by the broken line. This continuous change in position of the two halves of the diaphragm with respect to the pole pieces causes a corresponding change in the magnetic flux through them, and this in turn sets up an induced current in the coils of the divided pole pieces. This current is carried to the amplifying system, where it is amplified and then delivered to the horn or loudspeaker, and we finally have a sound which is a faithful copy of the original sound which existed in the recording studio at the time the record was made.

All of which would be simple if a diaphragm didn't have contrary and disconcerting vibration habits all its own. But it has. Almost everything has. You can easily demonstrate this for yourself. Take a glass tumbler and tap your finger lightly against it. You first hear the thump of your finger and in an instant you hear another tone that's a bit different from the first. The first tone was due to the blow from your finger; the second tone is due to the natural vibration of the tumbler itself.

It's just the same in the case of the diaphragm—the thing that bothers is the worthless vibration of the material in itself as a result of the useful vibrations transmitted from the needle; it is called "resonance." This resonance causes undesirable effects to manifest themselves in the sound, making some of the notes louder and some more thin, and now and then introducing some that shouldn't be there at all. All sorts of ways have been tried to overcome this trouble. ("Damping" is the technical term for the remedy, and is defined as the control of the free vibrations of a body so that their effect on the induced vibration will be minimized.)

Materials have been selected that would vibrate but little; other materials have been associated with the material of the diaphragm, as, for example, the rubber placed between the armature and the pole pieces of some types of reproducers for electrical phonographs. Many attempts to find a suitable damping material for the 4-A finally resulted in the adoption of oil as the best medium. The space back of the diaphragm and surrounding the pole pieces is filled with specially prepared oil of a certain quality. This eliminates the undesirable resonance of the diaphragm.

Value of Damping

Just how greatly the performance of a reproducer is improved by damping is graphically shown in Fig. 5. Here the "characteristic" of the reproducer—its performance at various sound frequencies or pitches (vibrations per second)—when undamped is indicated by the dotted line extending across the chart, while the full line indicates its performance when properly damped. Although the damping causes a slight loss in efficiency, as indicated by the full line falling below the dotted, yet it will be seen at once how the damping irons out the undesirable peaks and hollows of the undamped characteristic.

While the response characteristic of the reproducer is not a "flat" one, such variations as exist are compensated for elsewhere, so that the overall characteristic is essentially flat.

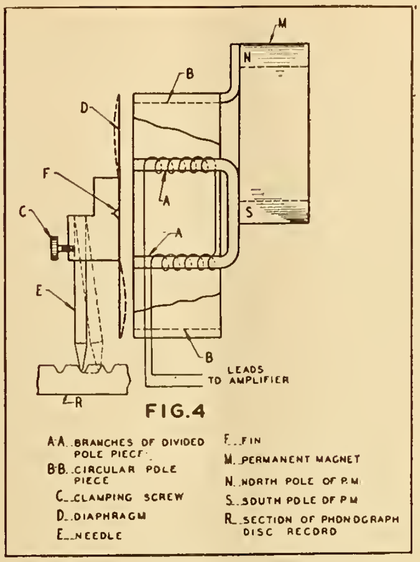


Fig. 4. Details of Construction

The 4-A reproducer is a delicate piece of apparatus and should be handled carefully. Never should attempts be made to open it or to adjust it in any way. The reason for this will be obvious when we remember the damping material. Both the quantity and quality of oil required have been determined after the most exacting investigations and tests, and it is virtually impossible for anyone except the manufacturer to adjust the reproducer satisfactorily.

Proper Needles Important

Much depends, too, upon the needle and upon the way the needle is placed in the reproducer. Only approved needles should be used. The needle should make an angle of 75° with the surface of the record when viewed at right angles to the reproducer arm, and 90° as viewed in line with the arm. Appreciable deviations from these angles will seriously affect the quality of the sound and will also quickly destroy the record.

If the bottom edge of the reproducer is not parallel to the record surface, a short needle or a slightly warped record may allow the lower part of the reproducer to strike the record and cause the needle to leave the groove. The pressure of the needle on the record is also of importance. The normal pressure is between four and four and a half ounces, equivalent to a load of from twenty to twenty-five *tons* per square inch. A pressure greater than normal will damage the record; less pressure may result in the needle jumping the groove. In either case the quality of the sound—the factor of prime importance in sound reproduction—will be adversely affected.

Progress Comparatively Recent

More progress in the art of sound reproduction from disc records has been made since 1922 than in the previous four and a half decades. Great as this progress has been, however, no one familiar with the subject believes that the last word has yet been spoken. Even now experiments are showing the possibilities of the vertical cut (the so-called "hill-and-dale") type of records.

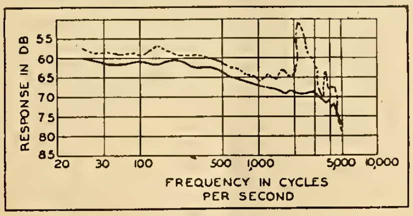


Fig. 5. Performance Curve

In this connection there has been developed an electrodynamic reproducer which seems to promise results beyond anything yet reached, one of its advantages being that of practically unlimited movement on low notes. In this type of reproducer a moving coil is direct-connected to the needle and floats in a strong magnetic field supplied by a permanent magnet. Moving in accordance with the undulations of the record groove, it thus generates a fluctuating current directly proportional in amplitude and frequency to the recorded sound.

Thus progress towards the ideal (absolutely faithful and complete reproduction of the original sound) is constantly being made. Regardless of the direction it takes or the form it assumes, of one thing we may be certain: that progress will continue.

S. K. Wolf to Leave for Paris in June

In response to an invitation to deliver a paper on the subject he specializes in before the International Electric Congress in Paris on July 5, S. K. Wolf, Director of the Acoustic Consulting Service of Electrical Research Products, will sail for Europe about the middle of June. The paper he will deliver, "Noise Investigation and Measurement in the U. S. A.," is the collaborative product of three authors: C. R. Hanna of the Westinghouse Company, H. B. Marvin of General Electric and Wolf.

During his trip abroad Wolf will study the progress of acoustic science in Europe.

French Want Fire Protection for Theatres at All Cost

According to a report submitted by American Trade Commissioner George R. Canty, it is now definitely understood that as of October 1, 1932, the French Government will enforce its decree making compulsory the use of non-inflammable stock in public film exhibition. This decree is 10 years old and its operation has been postponed six different times. It is understood that all films censored prior to October 1, 1932, will be exempt from the terms of decree in question, but that those submitted to censorship thereafter will be subject to its terms. No plausible reason is known for the decision of the Government to enforce the decree at this time, and there is considerable opinion that local film politics are connected with it. All trade interests will, it is understood, do whatever is possible to have the decree postponed again, including Agfa and Gavaert, German and Belgian companies respectively, that supply film stock to France.

The Problem of Non-Intermittent Projection*

By FORDYCE TUTTLE AND CHARLES D. REID †

The treatise is concluded in this issue with a classification of the various types of continuous projectors. Classification is made according to the optical means of forming the fixed image. The series ends with a summary of the non-intermittent projection situation as it exists today.—THE EDITOR.

Part III.

THE size of the astigmatic image is very materially reduced if the aperture of the lens is limited in the vertical dimension. We have to consider only a small pencil of rays passing through the plate. There are two unfortunate things about limiting this vertical angle, however: one, considerable light is lost, and two, it does not rid us of the distortion effect which is present with a tilted plate. Fig. 20 shows diagrammatically how this distortion is produced.

Correcting for Distortion

We can correct for such distortion almost entirely by the use of two plates, one on each side of the lens in a one-to-one system. In Fig. 21 we can see that rays which have a large angle of incidence for the first plate have a small angle of incidence for the second plate and vice versa.

If we are willing to use a cam to oscillate the plate and a long focal length lens with a restricted vertical aperture, we can have theoretically good projection with a single plate tilting in the beam. The screen picture, however, would be small unless we relay the image. The loss of light in such a system, especially with the relay and with a shutter which would cover the return of the plate, and have flicker blades, would rule out such a projector.

If we want to follow the film with uniformly rotating plates, we find in Fig. 22 that we will have to use a plate 3 inches thick, even for following 16 mm film over the displacement of plus or minus half a frame, and if we are to stay within our steadiness tolerance of .0005 inches. We can rotate this plate through an angle of only 8 degrees and since we will have to have another plate ready to follow the next frame, we will have to have 48 plates arranged in a drum. Such a projector would be quite impractical.

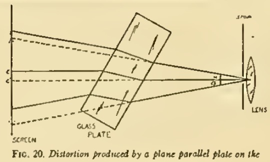


FIG. 20. *Distortion produced by a plane parallel plate on the short optical side of the projection lens.*

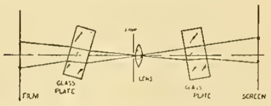


FIG. 21. *The partial correction of the distortion produced by a plane parallel plate by the use of two similar plates on opposite sides of a lens working at unit magnification.*

A very ingenious use of parallel plates can be found in one projector. By arranging plates as shown in Fig. 23 with the plates making an angle with their axis of rotation, but normal to the optical axis in their mid-position, it is possible to have the vertical component of the displacement produced very nearly linear with the angle of rotation. The undesired horizontal component of the displacement can be compensated for by having other plates rotating in the same manner some place in the system, in such a way that the vertical displacements are additive and the horizontal displacements offset one another. With this arrangement it is still necessary, however, to restrict the vertical angles subtended by the lens to get rid of astigmatism.

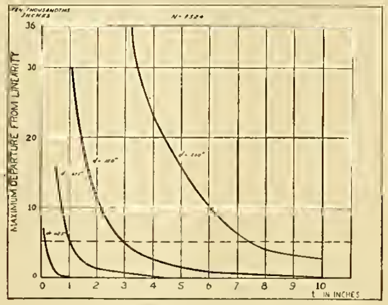


FIG. 22. *The departure from a linear relation between the displacement produced by a plane parallel plate and the angle of tilt with respect to plate thickness, for various total displacements.*

Moving Mirrors

Plane reflecting surfaces can be used in the beam without producing any defects in the image. The single tilting mirror, however, cannot be used alone without distorting the image. The method used for moving reflecting elements also introduces errors in the image.

In Fig. 24 there is shown a reflecting mirror tilted in the long optical side of a projection system. When the mirror is at 45 degrees the plane of the image formed by the system makes an angle of 90 degrees with the plane of the film gate. If the mirror is tilted through an angle sufficient to place the center of the frame, which is entirely above the axis of the lens on the center of the screen, the plane of the image does not correspond with the plane of the screen but falls along the dotted line shown in the figure. The image is rectilinear in its plane, and, of course, is not projected on to the screen plane as a rectilinear image, nor is it exactly in focus.

Because the image plane does not correspond to the screen plane, the screen image is distorted in two directions. Vertical lines on the film will not be parallel, the top edge of the picture being either narrower or wider than the bottom edge of the picture. Horizontal lines on the picture will be imaged as parallel lines on the screen, but horizontal lines equally spaced on the film will not be equally spaced on the screen. If the angle through which the mirror has to be tilted to keep the center of the frame imaged on the center of the screen is small, this keystoning distortion will not be serious. Hence, with a long focal length lens we will be able to tilt the mirror by some cam mechanism and have a satisfactory picture on the screen.

Avoiding Use of Cams

If we want to avoid the use of cams and change the angle of tilt of the mirror linearly with time, we can mount a series of mirrors on the periphery of a drum and rotate the drum with uniform angular velocity. This sort of system of moving the mirrors, however, will affect the steadiness of the center point of the picture on the screen. If we use a straight gate and the film is moving at a constant linear speed through this gate, it is the tangent of the angle which the center of the frame subtends at the lens from the axis of the lens, which is going to vary linearly with time and not the angle itself.

Mr. H. Dennis Taylor in a paper published in Photographic Journal, February, 1924, has shown that to get satisfactory projection with a system using a uniformly rotating drum of mirrors with 35 mm film, it is necessary to use about 60 mirrors in the drum. The possible ways of reducing the defects produced in the image by a tilting mirror which have been proposed are, the use of curved gates and the use of toroidal lenses. We feel certain that a curved gate could be used to correct to some extent for the distortion in the image. A very satisfactory projector has been designed which uses a series of cam actuated mirrors and a curved gate. A discussion of non-rectilinear lenses is beyond the scope of this paper.

Fig. 25 shows how two reflecting surfaces can be moved together and keep the image from moving film stationary on the screen. In this figure the reflecting surfaces are two faces of a right angle prism. It is evident that the mechanical problem of moving a series of prisms of this

---

* Journal, Optical Society of America.

† Development Department, Eastman Kodak Co., Rochester, N. Y.

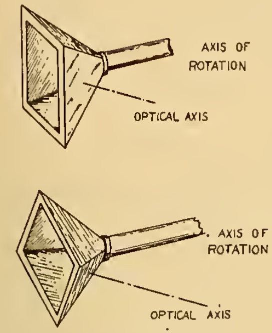


FIG. 23. *A special method of tilting plane parallel plates to produce a good approximation to a linear relation between the vertical component of the displacement and the angular displacement about the axis of rotation of the plates.*

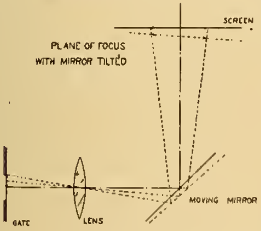


FIG. 24. *Optical compensation for the film motion produced by a tilting mirror in the light path.*

form at a constant linear speed and in a straight path in front of the gate is difficult. The correcting element occupies considerable space, and it is difficult to have a second element ready to follow a second frame past the gate as soon as the first frame reaches the bottom of the gate. Further, the size of the prism is considerable and the back focus of the projection lens has to be long.

In Fig. 26 we have shown how reflecting surfaces of rhomb prisms may be moved to give a vertical optical displacement of the image. A single rhomb gives a parallel displacement to light which is equal to the face of the rhomb. If the rhomb is held in one position in the projection system, this displacement is all a vertical displacement. If the rhomb is rotated through 90 degrees, the vertical displacement is zero, the whole displacement being horizontal. Horizontal displacements, of course, are not desired in a non-intermittent projector.

The figure shows how two rhombs may be rotated together in such a manner that the horizontal displacement of the image is zero and still allow a vertical displacement. If the wheels carrying the rhombs are rotated with uniform angular velocity, the displacement effected by the system varies not linearly but sinusoidally with time. Here again, then, we see that we will have to use a large number of rhombs to get satisfactory projection. We would like to point out that the path between the film and the lens is very long and we will have to use a long back focus lens for projecting with this system.

A number of inventors have proposed the use of spiral image-forming refracting or reflecting elements. These elements, of course, would be very difficult to make. Their only advantage would likely be in the fact that they would simplify the problems of moving the optical part in the beam. Their use would probably introduce a twisting distortion in the image.

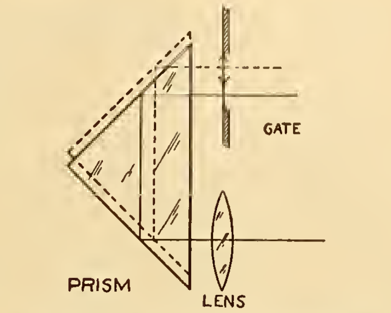


FIG. 25. *A method of following moving film by the motion of a prism reflector.*

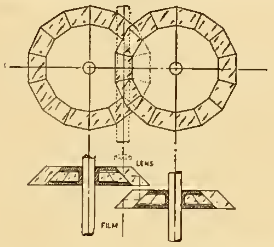


FIG. 26. *The use of pairs of reflecting rhombs to produce a stationary image from moving film.*

We know that the four types of

REFERENCE TABLE

MEANS USED	FLICKER	AMOUNT OF LIGHT	PRECISION REQUIREMENTS	NUMBER OF MATCHED OPTICAL PARTS REQUIRED	REMARKS
Reciprocating lens.	Quick return covered by shutter. Flicker blades necessary.	Might equal intermittent projectors.	Lens must be positioned during projection to within ±1/1500 of its total movement for 35 mm. film.	One.	Large mass in reciprocating part.
Series of lenses in restricted path.	Light not constant during changeover period.	Possible to get f/2. Diaphragm or shutter probably necessary.	As above. Probably harder to fulfill.	Determined by mechanical means used. Probably six or more.	Projector likely to be noisy and cumbersome.
Lenses moving with uniform circular motion.	As above.	As above.	Considerable precision required in initial adjustment and matching of parts. Accurate gears.	Twelve. Preferably more.	A projector using lenses in this manner can be made to give satisfactory results.
Uniformly rotating series of plates with normals to plates in a plane.	Practically no light to screen during changeover. Flicker shutter necessary.	Lens aperture limited because of astigmatism.	Not difficult to meet. Accurate gears.	Forty-eight (for 16 mm. film.)	Impractical.
Uniformly rotating plates with normals describing a cone.	As above.	As above.	Not difficult to meet.	Four or more (for 16 mm. film.)	Such a projector can be made to give satisfactory results, but is a little short on amount of light.
Uniformly rotating warped refracting elements.	Changeover can be very short.	Probably could be greater than intermittent projector light.	Elements very difficult to make, especially if they are achromatized.	One or several.	The longer the focal length of lens, the better the image.
Cam reciprocated mirrors.	With series of mirrors changeover period is short.	Might gain over intermittent machine.	Cams must control angular position of mirrors to within 1/1500 total angular movement.	Determined by mechanical means used. Eight satisfactory.	A projector of this type, the Mechau, has been built by Leitz and sold commercially.
Uniformly rotating drum of mirrors.	As above.	As above.	Accurate initial adjustment and gearing.	About sixty.	Most working models have had too few mirrors.
Rotating rhombs.	As above.	As above.	Rather difficult to fulfill. Accurate gears.	Sixteen or more.	This type can give satisfactory results. Long back focus required.

elements—lenses, prisms, plates and mirrors—can be used under proper conditions to produce satisfactory pictures as far as quality is concerned. The projected picture is steady enough, free enough from distortion, and the definition is passable. It is possible to have the number of glass-air surfaces small enough so that the picture is not made flat because of flare. In some cases we have found that the focal length of the lens has to be longer than desirable, and we might have to use a relay system for getting the image large enough on the screen. These relay systems would introduce additional surfaces which certainly may lose a considerable amount of light. In some cases we found that to get a satisfactory picture we had to limit the *F* aperture of the projection lens. This, of course, will cut down on light.

We have not discussed very fully the problem of keeping the light constant to the screen during the period which we use to change over from projecting from one frame to projecting from the successive frame. Any method we use, however, is very likely to limit the light to some part of the picture during the changeover period. With moving lenses there will be some barrel cutting and some loss of light from points which are considerably off the axis of the lens. With prisms we cannot change suddenly from a prism base side up to a prism base side down without covering up the period of that change. Plane parallel plates joined together so as to pass successively in front of the gate will have a dividing line between plates, which appears to the film, because of refraction, to have considerable width.

Even mirrors can hardly be joined together so that the dividing line between them is fine enough not to affect the light to the screen. Any change in the amount of light to the screen during the projection period demands the use of a shutter and flicker blades or some fixed diaphragm which will keep the light constant. Either method will lose light to the screen. Many of the systems require a moving condenser system to get even illumination.

Precision Requirements

The precision requirements on the mechanical parts used in a non-intermittent projector can be computed by finding the angle or distance through which we can move the optical elements with the film stationary without shifting the image on the screen an objectionable amount. The pitch of the sprocket must be equal to the pitch of the film to within .0005 inch in one perforation pitch, if we are going to project the picture continuously and keep that picture steady on the screen. It may be necessary to have the optical elements used precisely matched, and the initial adjustment of the elements precisely made. These precision requirements, of course, will add to the cost of producing the projector.

If we are going to gain in quietness of the projector, we cannot rapidly reciprocate parts which have considerable mass or moments of inertia. We can gain in quietness, however, if the projector design allows us to move all parts with constant angular velocity and have all parts counterbalanced.

Many of the systems proposed impose special limitations on the projector. For some of them to work satisfactorily they would have to have ridiculous physical dimensions. Some of them demand a fixed screen distance or a variable focal length auxiliary projection lens. Some of them demand a special arrangement of pictures on the film. Several do not provide any framing for the picture except at the screen. Very few of them could be considered as projectors for projecting lenticulated color film.

THE END

The Cathode Ray in Television

By ALLEN B. DUMONT*

SO much has been said and so little shown regarding the cathode ray tube that many hopes have been built up pending its introduction. Yet to those intimately familiar with the workings of both the cathode ray and the lens disc scanning systems, it becomes increasingly evident that until television broadcasters go to a greater number of lines, the latter system possesses many advantages which should not be overlooked.

In the first place, the real merits of the refined lens disc scanning system are realized by very few engineers and experimenters. The crude plain-hole disc, used in combination with the flat plate neon lamp, fails to provide the results now being obtained with the properly constructed lens disc and efficient neon crater lamp. The plain-hole disc produces relatively small images lacking in brilliancy. When enlarged by means of a magnifying lens, the images lack detail as well. Also, the scanning lines are too much in evidence in the form of an overall pattern. To obtain a fair sized image, a bulky disc is required, making for an awkward cabinet job.

With the refined lens disc, however, a marked improvement is scored in mechanical scanning. First of all, the amount of light available for the construction of the images is several thousand times greater than with the plain-hole disc, because of the more intense luminosity of the crater lamp as well as the greater amount of light passed by the lenses. Thus it becomes possible to project a spot of light on a screen, which feature is hardly feasible with the plain-hole disc and flat plate neon lamp combination. By means of projection, large images are obtained. With a 14-inch disc, for instance, a good 4 x 5 inch image may be projected, while with a 20-inch disc an 8 x 10 inch image is entirely practicable. The lens disc, of course, must be properly made, with lenses carefully matched as to size and diameter, and accurately mounted so as to place their respective spots at the proper lines. With a precise lens disc, together with the improved crater lamp, a bright, detailed image is obtained, practically free from any trace of screen.

Due to the cost of the lens disc, most television receivers so far offered to the public have employed a plain-hole disc. Therefore, the entertainment possibilities of present-day television have been practically unknown to the public until now, when, at last, moderate priced lens disc receivers are becoming available. With reasonable production schedules, a good lens disc television receiver is available at the price of the good broadcast receiver, providing really good pictures for the usual home group. The images are quite detailed, even when handling two or three characters at a time. Titles and other printed matter are entirely legible.

The cathode ray tube is certain to grow in desirability as television broadcasting attains higher standards, while the mechanical method must eventually lose ground. When the scanning system attains several hundred lines, the cost of present mechanical scanners will become prohibitive. Also, there may be more than one television scanning system employed by broadcasters, in which event the cathode ray possesses the advantage of ready change in number of lines. Even today, the cathode ray scanner can be built at no greater cost than the better type lens disc scanner. As television advances, however, the cathode ray scanner must become increasingly more economical. The matter of associated equipment also points to the economy effected by the cathode ray scanner, since it is possible to modulate the cathode ray with the detector tube output, or with not over 8 volts, thus doing away with the usual amplifier. This makes for simplicity and low cost on the receiver end.

In conclusion, the cathode ray is certain to be the ultimate choice for television scanning. Meanwhile however, let us not overlook the attractive possibilities of the lens disc scanner.

---

* Chief Engineer, Globe Television & Phone Corporation.

A "Push-Pull" Controversy

Mr. Williams Questions Mr. Preisman

The following letter from Mr. Scott Williams, Secretary and Treasurer of the Projectionist's Research Library, (sponsored by Local Union 321), Tampa, Florida, which questions Mr. Albert Preisman concerning certain statements contained in his recent article entitled "The Advantages of Push-Pull Amplification," which appeared in the April issue of this publication, and Mr. Preisman's reply which immediately follows Mr. Williams' letter are self-explanatory. It is gratifying to observe the keen interest which is being manifested in the subject.—THE EDITOR.

Mr. Williams' Letter

Editor, Motion Picture Projectionist:

In reading an article by an author with the prestige that Mr. Preisman enjoys, in a publication as outstanding as the MOTION PICTURE PROJECTIONIST is one is naturally slow to question the author's findings.

However, as I have given some time to the study of amplification, naturally when I read something that does not agree with my own findings, I at least want to satisfy myself one way or the other. I refer, of course, to the article "The Advantages of Push-Pull Amplification," page 12, April MOTION PICTURE PROJECTIONIST.

Mr. Preisman states that contrary to the claims of various manufacturers, the output of two tubes working in push-pull, is the same as two tubes working in parallel.

Now as I understand it, the maximum permissible harmonic output should be five per cent (the figure generally used by engineers in rating power tubes) in a type—71 tube this will give you about .7 watts output, at the same output two tubes in push-pull will have only seven-tenths of one per cent harmonic. The two tubes in push-pull can deliver almost three watts before the harmonic content reaches five per cent. These figures are quoted from an article in one of the past issues of the Bell System Technical Journal, by F. C. Willis, and L. E. Melhuish.

Mr. Preisman also states that the core of the output transformer may be made smaller. And while this may be true, I do not think it should be stressed, as the signal current will be at least twice, or if the above statement is accepted, almost three times as strong, and unless the transformer is well designed, the signal current will saturate the core on the peak of each cycle. I mention this because so many small badly designed transformers are on the market today.

If you know any simple way the above discussion may be demonstrated, I would surely appreciate hearing from you.

Scott Williams, Secretary and Treasurer, Projectionist's Research Library, Tampa, Florida.

Mr. Preisman's Reply

In an article as brief as that on "The Advantages of Push-Pull Amplification" must of necessity be, it was impossible to point out all the steps in the proof of any one statement. I therefore append here additional explanatory remarks, that, I believe, will clarify some of the statements which Mr. Scott Williams questions.

In the first place, if the tubes be "worked as hard" in a push-pull as in a parallel arrangement (same grid swing), and the reflected load impedance be the same to each tube, the outputs will be the same in either case, but the push-pull circuit will have less second harmonic distortion.

Suppose we use a greater grid swing for the latter circuit so that each grid goes positive on its positive half cycle. The grid will thereupon draw current, which flowing through its half of the secondary winding, will cause an impedance drop in the secondary. This must be subtracted from the generated secondary voltage, and since the grid goes positive near the peak value of this voltage, it will make the latter, and hence the plate current, flat-topped instead of peaked.

Referring to the article, it is obvious that such a flat-topped wave cannot be balanced by a flat-topped negative half cycle wave, hence the tubes cannot compensate for each other for this kind of distortion. This means that neither grid can go positive, and thus limits the grid swing to the same values as that for tubes in parallel. Hence the tube output cannot be increased by increasing the grid swing without distortion being produced.

Increasing the Output

There is, however, one way of increasing the output. To show this, let us consider one tube used in a push-pull arrangement with another, and then in parallel with the other. In either case, maximum output is obtained when the load impedance just equals the internal plate impedance of the tube. Since the plate current grid voltage characteristic is curved, and since this curvature is less the higher the load impedance is, it has been found that maximum *distortionless* output is obtained when the load impedance is *twice* the plate impedance.

However, in a push-pull circuit, this distortion is sufficiently cancelled even if the load impedance is made just equal to the plate impedance, so that the maximum power output is available instead of the lesser maximum undistorted output. (It is probably known to the readers that the same load impedance can be made to have any value to the plates of the tubes by a suitable choice of the turns ratio in the output transformer.)

Accordingly, let Rp be the internal plate impedance of the tube, and Mu Eg the equivalent alternating voltage generated in the plate circuit. Suppose the load impedance is twice the plate impedance, or 2Rp. The total resistance in the plate circuit is 3Rp and the A. C. Component

is equal to $\dfrac{\text{Mu Eg}}{3\ \text{Rp}}$

The power output is $I^2\,2\text{Rp}$

$$\text{And } I^2\,2\text{Rp} = \frac{(\text{Mu Eg})^2}{9\ R^2p} \times 2\ \text{Rp}$$

By a similar method of reasoning it can be shown that the power output when the load impedance just equals the plate impedance is

$$\frac{(\text{Mu Eg})^2}{4\ R^2p} \times \text{Rp}$$

The ratio of the latter to the former is 9/8 or 12½%. This is less than one decibel, and would be unnoticed by the ear. It represents the possible gain in power output of a push-pull amplifier over a parallel tube arrangement.

Since the push-pull circuit would have less distortion than the other, it might be possible to increase the grid swing somewhat for the same amount of distortion but the gain in power would be small, and the distortion-free advantage of the push-pull amplifier nullified. Hence it is difficult to see how Messrs. F. C. Willis and T. E. Melhuish obtained three watts output from a pair of—71 tubes unless the secondary of the input push-pull transformer had a very low impedance so that grid current did not produce an appreciable voltage drop in it and thus allowed a greater grid swing and power output. However, the output of a single tube could be increased in this manner, too.

Core Considerations

The question of the core size must be determined by the use of the transformer. If it is to be used as a voltage amplifying intermediate push-pull transformer between two push-pull stages, then the entire A.C. plate components of the first two tubes are used as magnetizing current in the

(*Continued on page* 29)

The Fundamentals of Sound

By LEDWARD EVERETT

The author continues his treatise on the Fundamentals of Sound with a discussion of frequency range, and fundamental and harmonic wave forms. A simple explanation of the development and structure of such wave formations is given.—THE EDITOR.

Part III

THE production of the human voice is accomplished in a manner slightly different from that obtaining when the tuning fork or the rubber band is used, but the action is analogous in that vibration is necessary in order to produce sound. Referring to Fig. 10, in which is illustrated a cross-section of the human head, the action involved is not difficult to understand. Briefly, it is as follows:

In the process of producing vocal sound, air which is forced up the windpipe (*trachea*) passes the vocal cords, which are set into vibration and sound waves are produced. These sound waves pass up into the mouth and are thence transmitted to the surrounding air. The vocal chords consist of muscular ledges or flaps. They are located at the upper end of the windpipe.

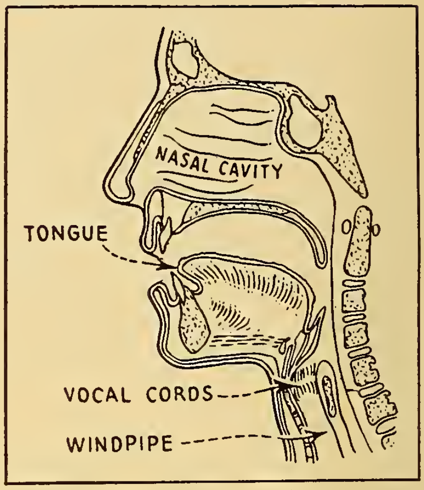


Fig. 10. *Human Vocal Mechanism*

Regarding the distinguishing characteristics of the individual voice, it may be said that there are cavities in the human head which make the sound waves vibrate with a certain quality that causes the voice of one person to sound different from that of another. Words and sounds of different pitch are produced by placing the tongue in various positions and by changing the shape of the mouth and throat by muscular action.

The frequency range of the human voice lies between eighty and twelve hundred cycles. It varies, however, within these limits with the individual, no person being able to cover the entire range. The voices of men are, of course, restricted to the lower frequencies and the voices of women to the higher frequencies. The human voice, therefore, includes the frequencies from the lowest note sung by a bass singer to the highest reached by the soprano.

In Fig. 11 a chart is given which shows the frequency range of various musical instruments and the human voice. The chart indicates the relation between the musical scale and the piano keyboard. Each note is given in terms of complete vibrations or cycles. The relation is according to the standard used in scientific work, that is, the scientific scale based on middle C at a frequency of 256 cycles. The shaded keys are added to carry the range beyond the piano keyboard. Immediately above the keyboard are shown the letters by which the various keys on the piano are known, viz.—A, B, C, D, E, F and G.

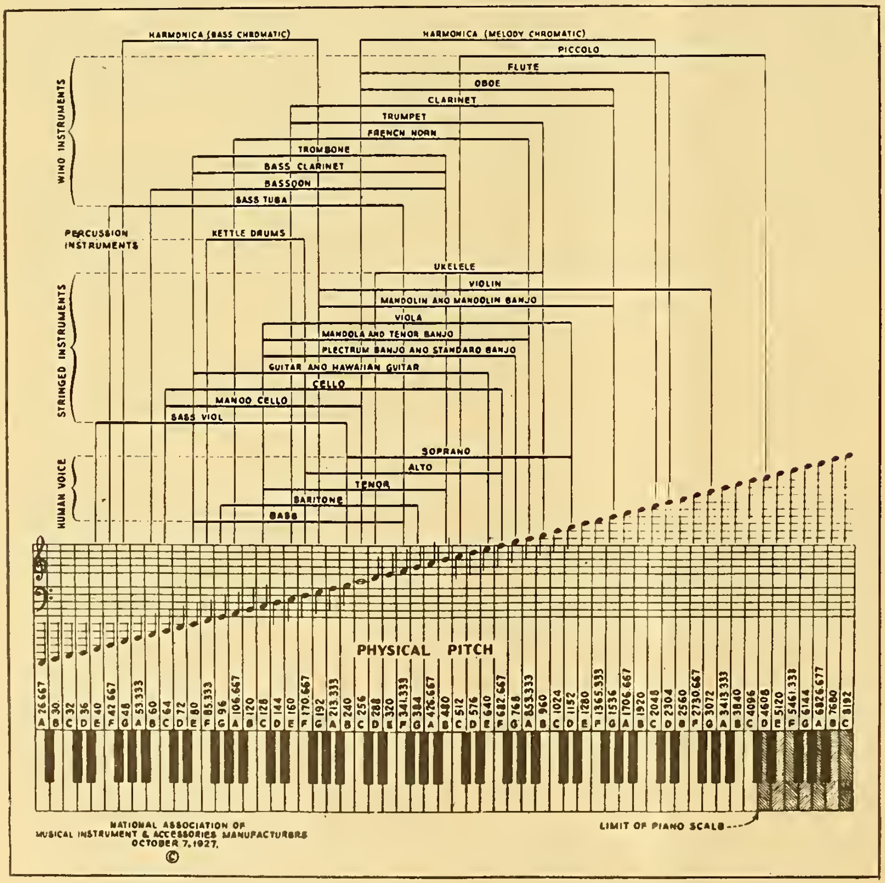


Fig. 11. *Range of Musical Instruments and Human Voice*

The numbers which are shown just above the letters on the chart indicate the frequency of vibration of each note. The range extends from 26.667 cycles for the lowest key to 4096 cycles for the highest key on the piano keyboard, and up to 8192 cycles for the highest note shown on the chart. The frequency range of the average organ lies between 16 cycles and 4138 cycles. An organ pipe has, however, been made which will produce a note vibrating at 15,600 cycles.

Voice Range

In singing the range covered is from 80 to 1200 cycles, but this range cannot be covered by one person's voice. It is to be noted that the frequency of 1200 cycles does not represent the highest frequency used in singing, because overtones of several times the frequency of the note are always present in the human voice.

The various ranges covered by singers are shown on the chart. The bass voice range is from about 80 to 341 cycles, the baritone from 96 to 384 cycles, the tenor from 128 to 480 cycles, the alto from 170 to 682 cycles and the soprano from 240 to 1200 cycles. As indicated on the chart, these various voices overlap so that each voice is able to reach a considerable number of notes within the next range. As a matter of fact,

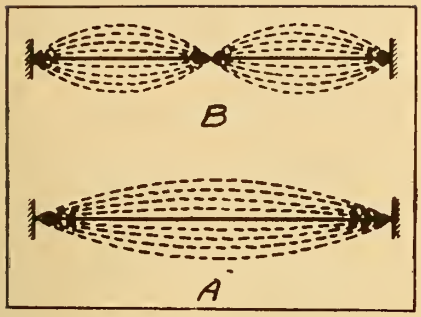


Fig. 12. *A: Fundamental. B: First Harmonic*

there are several notes common to all the voices shown.

At the left side of the chart are brackets which are labeled, "human voice," "stringed instruments," "percussion instruments" and "wind instruments." Each instrument has a clearly defined range of frequencies which it is able to produce and it will be seen that there is considerable overlapping in this instance also.

Harmonics or Overtones

The question which now arises is that if a certain note is within the range of several musical instruments and of the human voice, why is it that such instruments and voices possess certain characteristics which serve to identify them? For example, following up from middle C at 256 cycles we find that it is within the range of the human voice and of eight stringed instruments, nine wind instruments and the harmonica. Consequently, there are nineteen musical instruments which produce a note vibrating at 256 cycles, and yet no two of these instruments sound the same.

The answer is to be found in the fact that there are harmonics or overtones which accompany the fundamental frequency of every note. These harmonics differ for each instrument, so that a distinct quality of sound is lent to each note by the addition of the harmonics which are always present. The presence of harmonics is shown in simple form by comparing A and B, Fig. 12.

If a taut piano string is plucked at the center point, it will vibrate as a whole as shown in Fig. 12 A. This is the fundamental tone. Now, if the finger be placed on the middle of the string and then strike each half, the string will vibrate in two parts and will continue to maintain this form of vibration even after the finger is removed. The tone heard will be of a higher pitch than the fundamental, and, in fact. its frequency will be just twice that of the fundamental, each half of the string vibrating twice as rapidly as the string vibrates as a whole.

A note which vibrates twice as fast as the fundamental is known as the first harmonic, and the difference in pitch between the fundamental and the first harmonic is called an octave. The second harmonic vibrates three times as fast as the fundamental; the third harmonic, four times as fast, and so on.

This may be seen more clearly by referring once more to Fig. 11. For the purpose of demonstration let us say that the fundamental is middle C, which has a frequency of 256 cycles. Twice this frequency of vibration is 512 cycles. This is the first harmonic. It is found at the seventh key to the right of middle C. Three times the fundamental frequency is 768 cycles, which is the second harmonic. Four times the fundamental is equivalent to 1024. This is the third harmonic. There are very few sources of pure tones, that is, tones composed of the fundamental frequency and no harmonics.

The reason, therefore, that each instrument has a definite tone quality which causes it to produce a sound which is different from other instruments is that along with the fundamental vibration there are produced one or more harmonics. In the case of a stringed instrument, this means that the string vibrates as a whole and also in sections at the same time.

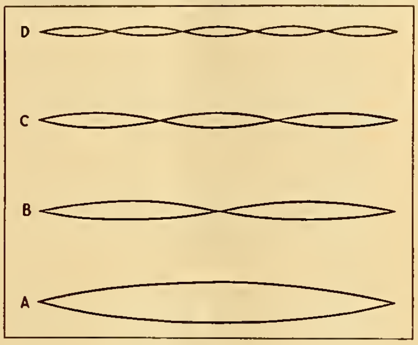


Fig. 13. *Fundamentals and Harmonic*

Production of Harmonics

In order to make this clear, let us refer to Fig. 13, which shows how a string that is vibrating as a whole and also in sections appears to the eye. In A it is vibrating as a whole and producing the fundamental tone. In B it is vibrating in two parts and producing the first harmonic of A. In C and in D it is vibrating in three and in five parts, respectively, and is producing in the case of C the second harmonic and in the case of D the fourth harmonic.

Now let us examine Fig. 14. If we assume that the wave form as shown in A is caused by a tuning fork which is sending sound waves into the air, and we start a second tuning fork vibrating which produces a wave as shown at B, which is twice the frequency of A, then we have two sounds in the air at the same time which, by acting upon each other, combine to produce a wave with the form shown at D. Now, if we start a third fork vibrating which sends out the wave form shown at C, which is three times the frequency of the wave A, then it will add its wave form and the combination of the three waves A, B and C acting together will result in the wave form shown in E.

By careful inspection, it will be seen that the addition of wave B to wave A lifted or lowered the form of A at certain points, making it as shown at D, and how the added effect of wave C altered the wave D in certain places, changing it to the form E. The effect on the ear of such a sound wave as shown at E is that of a fundamental with the pitch of A and in addition the added quality of "richness" of sound because of harmonics.

It should not be difficult to visualize in one's mind a piano string with the effect of the fundamental and say the first harmonic as shown at F. And so it is with the various string and wind instruments. The certain quality that enables the ear to recognize one from the other is brought about by various combinations of harmonics added to the fundamental. The tone pitch of a string is largely dependent upon its length, the longer it is the slower it vibrates, thus producing a sound wave of low frequency. As the length of the string is decreased, the more rapidly it vibrates, and the higher becomes the frequency of the sound it emits.

(To be continued)

They Need Them!

Trade Commissioner George R. Canty reports a novelty in the way of Cinemas in France. For the convenience of passengers changing trains at the St. Lazare station in Paris a news reel theater has recently been opened inside the station building.

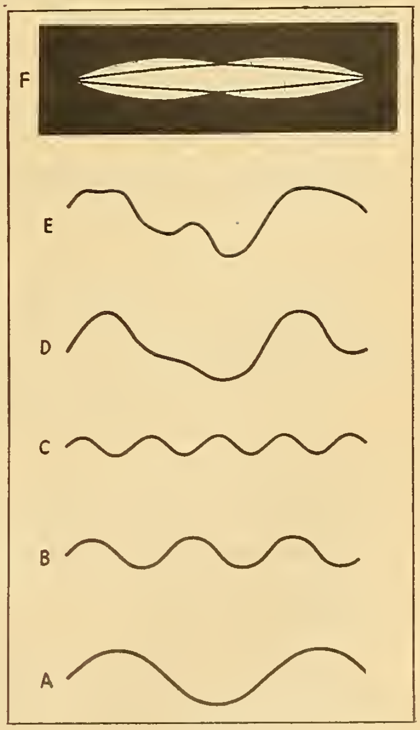


Fig. 14. *Reproduction of Tone Quality*

S.M.P.E. Tentative Program

Wardman Park Hotel, Washington, D. C.

MONDAY, MAY 9th

The morning will be devoted to the organization of the Convention, registration, meetings of committees, etc.

11:00 A. M. *Little Theatre;* Convention called to order:

Address of Welcome, by Hon. Sol Bloom, *Chairman*, Washington Bi-Centennial Celebration Committee.

Response by President A. N. Goldsmith.

2:00 P. M. *Little Theatre;* General Session:

"The Lapel Microphone and Its Applications to Public Address and Announcing Systems," by W. C. Jones and D. T. Bell, Bell Telephone Laboratories, New York, N. Y.

"A 16 Mm. Sound-on-Film Projector," by H. C. Holden, RCA-Victor Co., Camden, N. J.

"A 16 Mm. Sound Picture Projector," by H. Pfannenstiehel and R. A. Miller, Bell Telephone Laboratories, New York, N. Y.

(These two papers with demonstrations, will summarize recent progress in the design of sound equipment for the 16 mm. field, and should, therefore, be of widespread interest.)

"Biplanar Filament Lamps," by E. W. Beggs and T. J. Mili, Westinghouse Lamp Co., Bloomfield, N. J.

(The authors, who regard biplane filament construction as very attractive for projectors, propose it for standardization and will describe its advantages and characteristics. To be presented in two parts.)

"Extension of the Frequency Range of Film Recording and Reproduction," by G. L. Dimmick and H. Belar, RCA-Victor Co., Camden, N. J.

Report of Constitutional Committee:

(Presenting proposed amendments of the Constitution and By-Laws of the Society for adoption at this meeting; the importance of the proposed changes makes a full voting attendance very desirable.)

8:00 P. M. *Little Theatre;* Exhibition of recent talking motion pictures.

TUESDAY, MAY 10TH

10:00 A. M. *Little Theatre;* Committee Reports and Society Business:

(This session will be opened with a technical paper of outstanding interest, to be announced later.)

Report of the Standards Committee; M. C. Batsel, *Chairman*

(Including a discussion of 16 mm. sound-on-film, and proposed dimensional standards submitted to the Society for adoption.)

Report of the Projection Practice Committee; H. Rubin, *Chairman*

(Presenting the findings of the Committee as regards screen illumination, the adjustment of projectors for equalizing their outputs and the use of the standard release print in theatres.)

Report of the Sound Committee; H. B. Santee, *Chairman*

(Dealing with auditorium acoustics, the relation between studio and auditorium acoustics, the standardization of methods of compensating for losses in recording and reproducing, the use of increased volume range, and variations in sound negative exposures.)

Report of the Projection Screens Committee; S. K. Wolf, *Chairman:*

(Reporting studies on the specification and selection of screens from the acoustical standpoint, and methods of determining their illumination.)

Reports of Other Technical Committees.

2:00 P. M. *Little Theatre;* Photographic Session:

"Wave Form Analysis in Variable Density Recording," by O. Sandvik and V. C. Hall, Eastman Kodak Co., Rochester, N. Y.

"Illumination Problems in the Design of Projection Printers," by C. Tuttle and D. A. Young, Eastman Kodak Co., Rochester, N. Y.

"The Duplication of Motion Picture Negatives," by J. I. Crabtree and C. H. Schwingel, Eastman Kodak Co., Rochester, N. Y.

"Short Focus Lenses for Projection from Behind the Screen," by W. R. Rayton, Bausch & Lomb Optical Co., Rochester, N. Y.

"Motion Picture, 'Eyes of Science,'" by J. S. Watson, Rochester, N. Y. (Made for Bausch & Lomb Optical Co.)

"Precise Measurement of Filter Factors and Photographic Reflecting Powers," by L. A. Jones and J. W. McFarlane, Eastman Kodak Co., Rochester, N. Y.

"The Literature of the Motion Picture Industry," by G. E. Matthews, Eastman Kodak Co., Rochester, N. Y.

"Sensitometric Study of Certain Defects in Film Processing," by D. R. White, du Pont Film Manufacturing Corp., Parlin, N. J.

"The Bell & Howell Fully Automatic Sound and Picture Production Printer," by A. S. Howell, B. E. Stechbart, and R. F. Mitchell, Bell & Howell Company, Chicago, Ill.

8:00 P. M. *Little Theatre;* Lectures by Members of the Bureau of Standards:

"The General Work of the Bureau of Standards," by Dr. L. J. Briggs, Acting Director of the Bureau of Standards.

"The Optical Characteristics of the Camera Lens," by Dr. I. G. Gardner.

(These lectures will not be highly technical, and should, therefore, be of interest to a general audience.)

9:45 P. M. *Little Theatre;* Exhibition of recent talking Motion Pictures.

WEDNESDAY, MAY 11TH

9:30 A. M. *Little Theatre;* Projection Session:

"The Importance of Good Projection in Visual Education," by Chauncey L. Green, Minneapolis.

"The Weston Model 603 Illumination Meter," by R. T. Pierce, Weston Electrical Instrument Co., Newark, N. J.

"The Problem of Projecting Motion Pictures from Continuously Moving Film," by F. Tuttle and C. D. Reid, Eastman Kodak Co., Rochester, N. Y.

"The Bell & Howell-Cooke Varo Lens," by A. Warmisham and R. F. Mitchell, Bell & Howell Co., Chicago, Ill.

11:30 A. M. Motor buses leave the Wardman Park Hotel for the new building of the U. S. Department of Commerce.

12:00 M. *Department of Commerce Building;* Addresses by Heads of Government Departments:

(Mr. N. D. Golden, Chairman of the Local Arrangements Committee, is arranging for a group of short talks by several U. S. Governmental Heads, probably including Dr. Julius Klein, Bureau of Foreign and Domestic Commerce (perhaps, also, Secretary Lamont), the head of the Patent Office, and other department heads. Mr. C. J. North, Chief of the Motion Picture Division of the Department of Commerce, will introduce these officials to the Society.)

1:00 P. M. Visit to President Hoover (not definitely arranged as yet).

1:30 P. M. The afternoon is left open for recreation and sight-seeing. As this is the two-hundredth anniversary of the birth of George Washington, the Bi-Centennial Celebration makes the Capital City unusually attractive to visitors. Many interesting trips can be arranged for.

8:00 P. M. No program has been scheduled for this evening; in the event that no Society program is finally arranged for, passes to the *de luxe* motion picture theatres of Washington, available to those attending the Convention, may be used for this evening.

THURSDAY, MAY 12TH

10:00 A. M. *Little Theatre;* Release Print Session:

"Production Problems of the Release Print," by J. W. Coffman, Consolidated Film Industries, New York, N. Y.

"Theatre Problems of the Release Print," by H. Rubin, Paramount Publix Corp., New York, N. Y.

"Exchange Problems of the Release Print," author unassigned, Metro-Goldwyn-Mayer Pictures Corp., New York, N. Y.

(Each of these papers will be followed by invited discussion by leading authorities as well as extemporaneous discussion.)

"Treatments for Freshly Developed Film Gelatins," C. T. Faulkner, New York, N. Y.

(Mr. Faulkner's paper bears closely on the problem of providing theatres with well-conditioned prints ready for projection.)

2:00 P. M. *Little Theatre;* Theatre Operation Session:

"The Ideal Theatre," by S. L. Rothafel, Radio-Keith-Orpheum Corp., New York, N. Y.

(*Continued on page* 28)

Theory and Fundamentals

By W. W. JONES

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Engineering Department of RCA Photophone and has been closely identified with the educational activities of that organization since the time of its inception. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that institution.—THE EDITOR.

Controlling Sound Volume In the Auditorium

IN the past all theatre sound reproducing equipments have been provided with volume controls located either on the amplifier rack of the equipment or on the front wall of the projection room. With the volume control so located in the projection room, it is necessary for the projectionist on duty to assume the responsibility for proper sound volume in the theatre auditorium.

In order to aid the projectionist in the proper performance of his duty most projection rooms have been equipped with a monitoring speaker. While the monitoring speaker has been an aid to the projectionist, it has not eliminated the problem of volume control. It does indicate to the projectionist whether or not he has sound in the auditorium. It also will serve immediate warning in the event of a sudden failure of sound, or in the event the projectionist has failed to manipulate his sound fader or change-over devices properly. Where a projectionist is particularly alert and experienced on a particular equipment he may judge by the monitoring speaker whether or not the sound in the auditorium is so loud as to be annoying, or whether or not it is so low as to be unintelligible and difficult to hear. Thus, at best, the monitoring speaker serves to indicate either failure of sound or limits of volume.

Signaling Devices

In some theatres the monitoring speaker has been supplemented by some sort of a signaling device. This device in some cases is the house telephone. In others it may be a visual signaling system consisting of a drop annunciator or a pilot light arrangement with signal stations located at convenient points in the auditorium. Still a third system, commonly used, consists of a simple buzzer system.

It can be seen from the above systems supplementing the monitoring speaker just what the tendency is with respect to auditorium volume control. This tendency seems to indicate that the volume should be controlled from the auditorium. There are reasons for this, and no doubt they can be accounted for.

With the volume control located in the projection room there is no question but that the projectionist shall be responsible for sound volume. He is operating the equipment, and the controls are convenient for his use only. Now we shall see whether or not the projectionist should be entirely responsible for sound volume. First of all, he has a multiplicity of other responsibilities.

Secondly, with these responsibilities he cannot divide attention on the job so that he may observe the volume continuously. If a sound program is to be presented properly the volume should be observed by a person located continuously in the auditorium. This person so located can then by means of the signaling system signal the projectionist either to raise or lower the volume. The projectionist then can make the change according to the signals. In order to make the change in volume the projectionist must leave his other duties.

Disadvantages of System

The disadvantage of the signaling system lies in the fact that time is required from the time the signal is given to the time the volume is actually changed. This means, of course, the change in volume may occur too late and thus interfere with the sound effect desired. Where the telephone is used as a means of signaling the delay is most noticeable.

However, the telephone is a more accurate means of receiving signals. That is, once the instructions are received the volume control may be adjusted accurately and as intended by the observer in the auditorium. In the case of the visual signaling, or the buzzer systems it is possible to receive signals which indicate only that the volume is to be raised or lowered. That is, it is impossible to receive signals indicating just how much the volume is to be raised or lowered.

Because of the tendencies in volume control outlined above, and because of the difficulties encountered with signaling systems, at least one manufacturer is offering to theatre owners sound reproducing equipment equipped with what is termed remote volume control.

The remote volume control system consists of an electrical driving mechanism located on the amplifier rack, a volume indicator located in the projection room, and a series of push-button stations. The driving mechanism changes the volume control setting almost instantaneously when one of the push-button stations is operated. The volume indicator located in the projection room indicates to the projectionist the exact volume control setting. Push-button stations are located at the operating position of each projector, and in addition they are located in various positions in the theatre auditorium from which it is desired to control the volume. Each push-button station is equipped with a set of two buttons. One button if pressed raises the volume and the other lowers the volume. In operation the volume is either lowered or raised as long as the corresponding button is depressed.

With such a system as the remote volume control system described above it is possible to have located in the auditorium a trained person whose duty it is to maintain proper volume. This will relieve the projectionist of the divided responsibility which he has had in the past and which he now has.

The remote volume control system in no way decreases the importance of the projectionist's position. It does not take away any of the controls which he has had in the past. In fact it makes it possible for the projectionist to devote his entire attention to the proper operation of his sound and projection equipment, and in addition places the volume control conveniently in the operating position of each projector.

Bureau of Standards to Be S. M. P. E. Host

The Bureau of Standards will play host to the members of the Society of Motion Picture Engineers, Tuesday evening, May 10, during the Spring Meeting of the Society in Washington, D. C.

At this meeting Dr. L. J. Briggs, Acting Director of the Bureau, will describe work carried on by the Bureau of interest to the motion picture industry. Dr. I. G. Gardner will deliver a demonstration and talk on optical phenomena.

New Circuit Breaker

The Westinghouse Electric and Manufacturing Company announces its new line of "De-ion" circuit breakers. These breakers use a new method of arc extinction that enables elimination of all fuses in panel-boards distribution switchboards within the breaker's capacity and industrial applications where fused safety switches are now used.

New Equipment and Appliances

New Arc Rectifier

A NEW rectifier, which is to be known as the M.P. 25-25 model, has been placed on the market by the Forest Electric Corporation of Newark, N. J. This new equipment, it is said, has been designed to meet the demand for a single unit which will supply two projectors, and which will furnish from 15 to 25 amperes to either projector continuously.

The unit utilizes four rectifier tubes which are connected in such a manner as to supply current to two direct current circuits independently of each other. This arrangement prevents loss of current at the first arc when the second arc is struck.

The primary advantage of this circuit is that both arcs can be operated at the same time during change-over without diminishing the light at the first projector while striking the arc at the second.

A single projector model known as the M.P. 15 for use in smaller houses, schools and churches where a maximum current of 15 amperes is sufficient, is also being marketed by the company.

S. O. S. Issues Catalog

What is considered by many to be one of the most comprehensive and yet most condensed catalogs which have been published in the theatre trade, is now being distributed by the S.O.S. Corporation of New York.

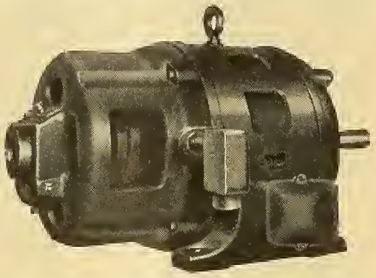
The catalog is unique in that considerable space has been devoted to description of rebuilt and reconditioned apparatus, such equipment being dealt with almost exclusively by the Salvage Department of the company. The volume is profusely illustrated and separate sections are devoted to sound equipment, projection machines, lighting apparatus, lobby displays, 16 mm. equipment and recording systems.

Slip Ring Motors

The Century Electric Company of St. Louis, Mo., has announced the extension of its line of slip ring motors from 20 horsepower to 250 horsepower. The motors are rated at 1800 R.P.M. and are adapted for 60-cycle two and three-phase supply.

The units are desirable for installations where high starting torque is required and low starting current is desirable or where heavy inertia loads increase the time required to bring the load up to full speed.

The motors are adapted to two classes of service—constant speed or adjustable varying speed. The only difference between the two installations is in the secondary control equipment. The control consists of a manual or magnetic primary switch to connect the motor to the supply circuit and a secondary control for reducing the starting current on constant speed applications, or for adjusting the speed on the adjustable varying speed applications. It is practical to provide a speed reduction of as much as fifty per cent.



The primary switch, if magnetic, may be interlocked with the secondary control.

Elaborate Sound Installations for Rockefeller Center

The most complete system of sound reproducing and amplifying equipment ever designed for a theater will be installed in the new Sound Motion Theatre, between 48th and 49th Streets, in Rockefeller Center, according to an announcement made today by Metropolitan Square Corporation, holding company for John D. Rockefeller, Jr. The contract for this equipment has been awarded to the Photophone Division of the R. C. A.-Victor Company, according to the announcement.

The steel work for this new theater, which will seat 3,500 persons, is now being erected. The theater will open next autumn. It will be operated by the Radio-Keith-Orpheum Corporation under the direction of S. L. Rothafel ("Roxy"), as will the International Music Hall, in the north block.

Four standard size Photophone reproducing units, an 80-watt double channel amplifier in the projection booth, and four 50-inch loud speakers on the stage will be used in connection with the reproduction of sound motion pictures in this theater. In addition, there will be a public address system, with 25 microphones, to reinforce the stage productions.

Unusual features of the installation include a rehearsal system for use in connection with the direction of productions; a stage manager's call system and 52 "Acousticon" seat phones, attached to selected seats for the benefit of the hard of hearing. Complete radio and phonograph equipment in the projection booth will make it possible to transmit radio or phonograph programs to the audience at any time.

The rehearsal system is said to be the latest development of its kind. With it the stage director, carrying a microphone, may conduct his rehearsals from any position in the auditorium of the theater through the medium of loud speakers on the stage.

The stage manager's call system is another innovation. It enables the stage manager to communicate with any part of the theater through a microphone on his desk.

The "Acousticon" seat phones should prove a great boon to theater patrons who through partial loss of hearing have been unable, heretofore, to enjoy fully the sound motion pictures.

Army Air Corps Studies New "Zoom" Lens

The war and peacetime possibilities in military aerial photography of the new "Zoom" lens, recently developed by the Bell & Howell Company for standard motion picture cameras, are attracting the attention of the United States Army.

This lens was primarily developed to "zoom" or "swoop" down on a subject or to recede from it without moving the camera or scene. For instance, with the new lens, a parachute jumper can be shot as a "close-up" all the way down to a landing place, or he can be photographed alternately "close-up" and at actual distance. In such operations the positions of the lens elements are changed, but the position of the camera remains the same.

Lieut. George W. Goddard, director of the Photographic Department of the Army Air Corps at Rantoul, Ill., has just completed a series of airplane photographic tests of this lens in flights over Chicago which disclosed tremendously interesting results from a military standpoint.

Sound Meter Test Made in Opera House

An instrument, known as the audio sound meter, recently developed by the General Electric Company, was used on April 27 during a special performance of Rigoletto at the Metropolitan Opera House, New York City.

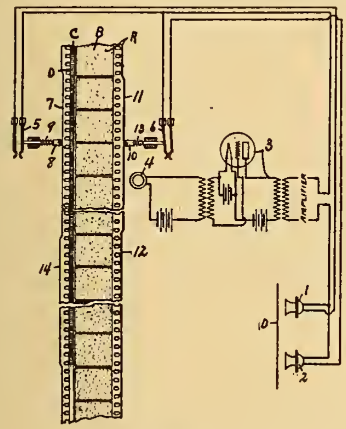
The device, it is said, records not only sounds created by the singers and instrumentalists, but also those created by the audience. The meter is so designed that it converts sound into electric currents, amplifies and detects them, and compares the result with other sounds of known intensity. The results are given in decibels.

The instrument, it is reported, has already proved to be of great value in the location, measurement and control of insidious noises.

RECENT PATENTS

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 277 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine, and enclosing fifteen cents to cover costs.

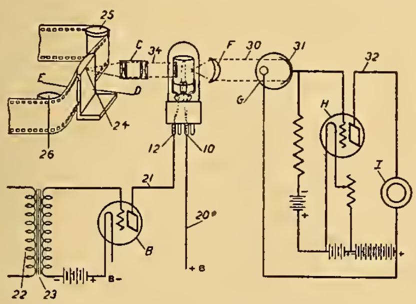
1,851,117. MOVING TALKING PICTURE APPARATUS. EARL I. SPONABLE, New York, N. Y., assignor to Fox-Case Corporation, New York, N. Y., a Corporation of New York. Filed Jan. 17, 1929. Serial No. 333,212. 2 Claims. (Cl. 179—100.3.)



1. In the reproduction of sound moving pictures from a film provided with a plurality of recesses along its opposed edges, a plurality of loud speakers, a common amplifier circuit therefor, switching means disposed along opposed edges of said film in circuit with said speakers and said amplifier and comprising an actuating member adapted to ride in and out of said recesses whereby said speakers are selectively connected and disconnected from said amplifier circuit.

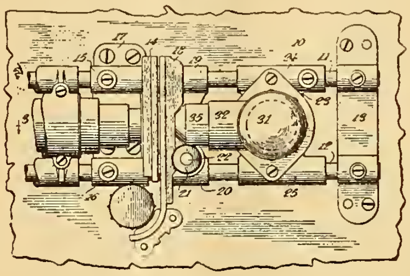
▲

1,850,467. MONITOR METHOD OF RECORDING SOUND ON FILM. THEODORUS H. NAKKEN, Brooklyn, N. Y., assignor to Nakken Patents Corporation, a Corporation of Delaware. Filed June 12, 1929. Serial No. 370,292. 1 Claim. (Cl. 179—100.3.)



In the photographic recording of sound, a glow lamp having separate light apertures; means for exposing a movable photographically sensitized strip in photographic cooperation with the light emanating from one of said apertures; a photoelectric couple including a photoelectric body cooperatively arranged with respect to the other of said apertures; a sound reproducing device; an amplifier apparatus cooperatively connecting an element of said photoelectric couple with said sound device; and means for modulating the intensity of the light of said glow lamp in accordance with sound to be recorded.

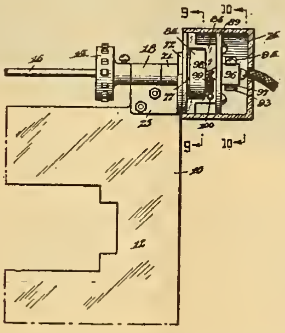
1,847,643. SUPPORT AND ADJUSTMENT FOR SPEAKING MOVIE PHOTO CELLS. AUGUSTO DINA, Elizabeth, N. J., assignor to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed Mar. 31, 1930. Serial No. 440,204, 5 Claims. (Cl. 179—100.3.)



1. In a motion picture apparatus, a film trap gate and door, a pair of rods, a partition on which said rods are horizontally spaced to act as supports, said gate and door slidable along said rods, means on the door to be moved and engaging the rods to move the door along the rods, a photo cell slidably disposed on the rods, a tubular member extending from the cell, an enclosing casing around the cell to which the tubular member is attached, a similar tubular member on the door on the face adjacent the cell, said last mentioned tubular member having always, and independent of the position relatively between the cell and the door, a telescopic relation with the tubular member on the cell to prevent the straying of the light passing from the door to the cell.

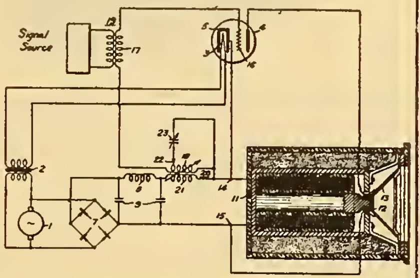
▲

1,847,075. SAFETY SWITCH FOR MOTION PICTURE PROJECTING MACHINES. THOMAS TWADDEL ALLEN and CHARLES KENNETH GIBBS, Philadelphia, Pa., assignors to Sentry Safety Control Corporation, Philadelphia, Pa., a Corporation of Delaware. Filed June 18, 1928. Serial No. 286,377. 3 Claims. (Cl. 200—52.)



1. A safety switch for motion picture projecting machines comprising a shaft having sprockets for engagement by the film, a switch comprising centrifugal flyweights mounted on said shaft, a friction drum adapted to be frictionally engaged by said flyweights, a cam on said drum, and contacts adapted to be opened and closed by said cam.

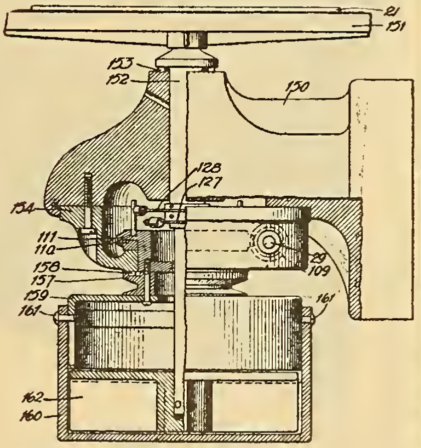
1,849,495. SOUND REPRODUCING DEVICE. FREDERICK W. LYLE, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, a Corporation of Pennsylvania. Filed Sept. 18, 1929. Serial No. 393,405. 3 Claims. (Cl. 179—171.)



1. In combination, an electrodynamic loud speaker having a field coil and a voice coil, a vacuum-tube amplifier having a grid circuit and a plate circuit, a common source of current supply connected to said plate circuit and field coil, the voice coil being in series in said plate circuit and the field coil in shunt thereto and a transformer coupling said common connection to said grid circuit.

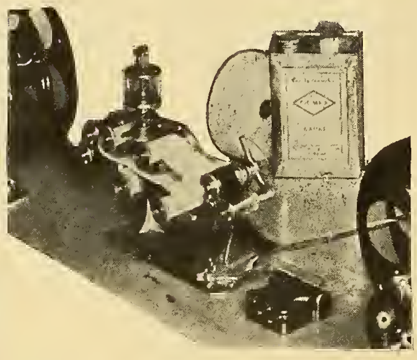
▲

1,847,181. TALKING MOTION PICTURE SYSTEM. HENRY C. HARRISON, Port Washington, N. Y., assignor to Western Electric Company, Incorporated, New York, N. Y., a Corporation of New York. Continuation of application Serial No. 682,855, filed Dec. 27, 1923. This application filed May 26, 1926. Serial No. 111,707. 5 Claims. (Cl. 74—6.)



1. In a sound recording or reproducing device, a record drive comprising a turntable, a flywheel member adapted to rotate on the same axis with said turntable, a driving motor coupled to said flywheel member and a spring coupling between said flywheel and said turntable, the masses of said turntable and said flywheel member and the compliance of said spring coupling being sufficiently large to prevent the transmission from the motor to the turntable of periodic angular oscillations of a period less than about one second.

Clean Films



Clean films mean good sound and picture. Our WIPER-CLEANER together with our FILMEX CLEANING FLUID removes oil and surface dirt which is so detrimental to good sound and picture projection.

Write for our interesting booklet

Film Processing Machinery Corporation
354 West 44th Street
New York City, New York

Patents:

A department established for the solution of patent difficulties.

By RAY B. WHITMAN

Readers are urged to avail themselves of this free service for advice on the subjects of Patents, Trade Marks, Designs and Copyrights. If a personal answer is desired, a stamp should be enclosed with the inquiry; otherwise the question and its answer will appear in this department in the first available issue. Address all questions to the Patent Editor in care of THE MOTION PICTURE PROJECTIONIST. *Write on one side of the paper only, giving full name and address and business connection. (Only initials will be published if requested.)*

Q. Is a knowledge of expired patents in his field of any value to a manufacturer of a product? *L. M. D., Los Angeles, Calif.*

A. Yes, very much so. There are several hundred patents expiring every week and information as to these may be obtained from the Official Patent Office Gazettes of 17 years ago, of which there are copies in the public libraries of many of our large cities. Often a manufacturer finds in expired patents some product which has enjoyed a wide and profitable sale for many years but which he had been stopped from making in competition because of the patent rights. As soon as he sees the patent which has expired on such a product, he knows he is no longer barred from competing in its manufacture and sale and cases of this kind happen often and the information to you obtained from the expired patents is frequently of great value.

Q. Can a patent be valid in one part of the United States and invalid in another? *R. T. K., Atlanta, Ga.*

A. Yes; the reason for this is that the United States is divided into nine circuits, each with a court which passes upon the validity of patents in that section of the country. It sometimes happens that one circuit or district holds a patent valid and another holds it invalid, and so the owner of it may collect profits and damages from infringers in the circuit where it is valid, although he cannot do so in the circuit which held it invalid. However, in order to determine its actual and permanent validity, it is necessary to appeal the adverse decision to a higher court, and if such adverse decision is reversed, then it becomes valid throughout all districts. Likewise, the reverse is the case and it might be held invalid throughout all districts.

Q. Is it better to license the rights to an invention when the patent is still in the application stage, or should I wait until the patent has issued? *J. D. O'C., Battle Creek, Mich.*

A. It is usually better to sell or license your rights as soon as possible and before the patent issues and such contracts are perfectly binding.

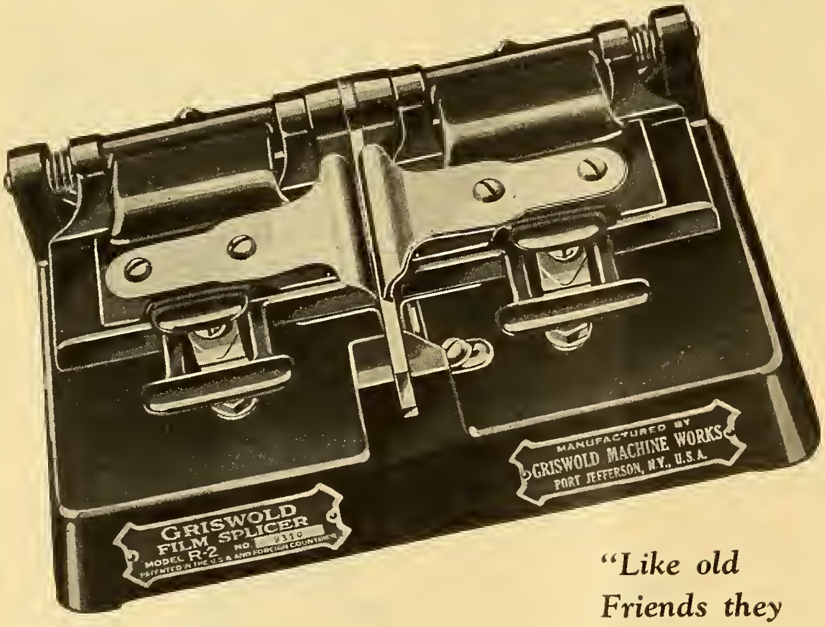
S. M. P. E. Program

(*Continued from page* 24)

"How Can the S. M. P. E. Be of Greater Service to Theatre Managers?" by C. Lewis, *Motion Picture Herald*, New York, N. Y.
(Mr. Lewis is Manager of the Round Table Department of the *Motion Picture Herald* and thus is in touch with a very large number of theatre managers.)

"Theatre Operation Problems," by M. A. Lightman, President, Motion Picture Theatre Owners of America.
(The Convention of the M. P. T. O. A. has recently just been concluded in Washington, and Mr. Lightman's statement of the problems of the theatre should be especially timely.)

"Problems of Theatre Operation," by S. Sumner, University Theatre, Cambridge, Mass.
(Mr. Sumner has taken part in the discussion of previous papers on exhibition



"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS
Port Jefferson, Long Island New York

before the Society, and has contributed sound ideas and shown an appreciation of the viewpoint of the motion picture engineer.)

"Problems of the Theatre Manager," by N. Glasser, Assistant Zone Manager, Warner Bros., Washington, D. C.

(Mr. Glasser's services have been secured by Mr. N. D. Golden to represent in this symposium, the views of the Washington Theatre Managers.)

"Tools That the Service Man Uses," by J. A. Mauran, RCA-Victor Co., Camden, N. J.

(This paper, as its title indicates, deals with the problem of servicing equipment in theatres.)

It is the hope of the Papers Committee that free discussion by the members will take place at this session, so that the viewpoints of the invited speakers may be most clearly brought out. For this reason the number of papers has been limited.

7:00 P. M. *Gold Room;* Wardman Park Hotel:

Semi-Annual Banquet of the S. M. P. E.

Adjournment of the Convention.

Note—A number of important papers written by Hollywood engineers will be given prominence on this program as soon as they are more definitely assured; these will deal with portable recording equipment, sensitometry, editing of previews, film editing, and the making of animated cartoons.

Convention Committee,
W. C. KUNZMANN, *Chairman*
Papers Committee,
O. M. GLUNT, *Chairman*

A "Push-Pull" Controversy

(*Continued from page* 21)

primary windings. The A.C. component in each tube varies from zero to twice the value of the D.C. component for maximum grid swing. The flux must not saturate the core, hence the peak plate current cannot exceed the value that would produce saturation, and so the D.C. component (average value of the plate current) must be half of this maximum permissible value.

If the D.C. components are made to cancel out as in push-pull amplification, the flux change can be twice as great and the voltage produced in the secondary twice as great. This would represent *four* times the power output in the next pair of tubes, and not twice, as Mr. Williams suggests. It is to be noted that if the power is twice as great, the voltage is $\sqrt{2}$ times as great which makes the power $\sqrt{2}E \times \sqrt{2}I = 2EI$, or twice its original value of EI. Thus, for the same voltage input, the core of the intermediate transformer can be made approximately half the area for one tube.

The Output Transformer

In the case of the push-pull output transformer the saving is even greater. Here, as in the above case, the maximum value of the A.C. component is equal to the D.C. component for maximum permissible grid swing. This A.C. component must be divided into two vectorial parts: one part to

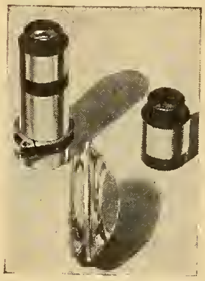
TAKE THE
EYE-WAY
TO
GREATER PROFITS

ACTION . . . Thrill . . . Pleasure . . . the real enjoyment of the show comes to your patrons through their eyes. Put it on with Super Cinephors . . . the lens that gives your audience sharp, clear, easy-to-watch pictures. Let them settle back in complete enjoyment when they come to *your* theatre.

Super Cinephors can be used with either regular or wide screens with equal effectiveness . . . they project with the same clear-cut definition to either size. Used with the new patented B & L Condensing System they transmit to the screen 50 to 100% more light. You get high screen brilliance even with the perforated screen. Correction is complete for both spherical and chromatic aberration. Strong contrast, maximum detail and exceptional flatness of field is assured.

Beat your competition. Install Super Cinephors. Ask your National Theatre Supply man. And

SEND THE COUPON



BAUSCH & LOMB OPTICAL CO.
680 St. Paul Street Rochester, N. Y.

Please send me right away all the information on the new Super Cinephors and the patented Condenser System.

Name ....
Address ....
City .... State....................

TALKING PICTURES

BY BERNARD BROWN

A detailed discussion of the principles of construction and operation of sound film apparatus including a complete history of its development. Of great importance is the full account of R.C.A. power system and the Western Electric speaker unit. Specially valuable for operators, technicians, and also the general reader. Many illustrations and charts. Second Edition. **$3.00.**

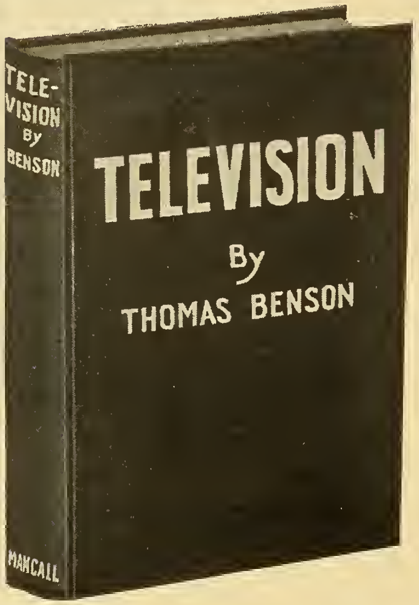
TELEVISION—TODAY and TOMORROW

By Sydney A. Moseley and H. J. Barton-Chapple. $2.50.

Write for descriptive lists

ISAAC PITMAN & SONS, 2 West 45th Street, New York

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today. It is a book both for the interested layman and for the craftsman who will shortly depend on television operation for his livelihood. It has been written especially for the motion picture projectionist who will unquestionably operate television in the theatre as he now does sound equipment. The serious projectionist will get a copy at once.

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

TELEVISION
By Benson $2.00

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th Street, New York City
Enclosed find money order for $2.00.
Please send me Benson's Television.

Name ....
Address ....
City and State..............................
Theatre ....

furnish the magnetic flux which induces voltage in the secondary (and C.E.M.F. in the primary) and the other part which is the primary equivalent of the secondary load current.

The former is called the magnetizing current and, as stated above, furnishes the flux; the latter is the primary equivalent load current, and balances the secondary load current, so that the latter will not set up any appreciable magnetic flux and thus interfere with the magnetizing current. The two load currents do "squeeze" out some leakage flux between the primary and secondary windings, but this should be small in order that no marked attenuation of the higher frequencies result.

Design Considerations

In a well designed transformer, the magnetizing current should be low—let us say only 15% of the total A.C. component at the lowest frequency. (This is a rather liberal figure.) The magnetizing current will therefore be about 15% of the D.C. component. For an economic design, the output transformer for a single or parallel tube circuit can thus have a D.C. flux nearly 85% of the saturation value, so that the magnetizing flux will carry it almost up to saturation on the positive half cycle. This is an approximate statement, as will be explained below. Thus the core has to be designed mainly with the D.C. flux requirements in mind.

If the D.C. component is eliminated, as in a push-pull circuit, the core can be very considerably reduced, as the A.C. flux is but a small portion of the combined D.C. and A.C. flux. This is true even for twice the power output, for the induced voltage need only be $\sqrt{2}$ times its previous value. (Please note that in a transformer the A.C. flux required is in proportion to the impressed voltage, and not the current.)

A further point is that when D.C. is present, the superimposed A.C. does not carry the flux along the D.C. magnetization curve, but along a hysteresis curve which is more nearly parallel to the horizontal axis (ampere turns). This means that the reluctance to A.C. flux is greater than if D.C. is absent, which is another point in favor of the push-pull circuit.

Less Magnetizing Current

Finally, there is one additional point seldom realized by the average man, and that is that a transformer draws less magnetizing current when excited from its high tension side than from its low tension winding. Thus, assume a 2:1 turn ratio. The open-circuit impedance (mainly inductance) ratio is 4:1. The voltage ratio is 2:1, hence the current ratio is 1:2, respectively.

This means that the magnetizing current drawn by a push-pull output transformer is ½ or 50% of that drawn by a single or parallel tube output transformer for the same secondary voltage. This means that the primary (and secondary turns) can be reduced, or, if kept the same, that the voltage drop in the tube due to magnetizing current is correspondingly less. This is of importance at the lower end of the frequency band.

I trust that the above satisfactorily answers Mr. Scott Williams questions. It has been a pleasure to read his intelligent comments and to have this opportunity to discuss them.—*Albert Preisman, Instructor, RCA. Institute.*

New Amplifier Tube

(*Continued from page* 9)

not necessarily serious. At rated load this divergence amounts to less than 1½ d.b.

Fig. 5 shows the overall power output and harmonic distortion plotted as a function of load impedance. It will be noted that the second harmonic predominates and that the third is constant at higher load values, which makes the tube ideal for push-pull application.

Frequency Response

The frequency response of the typical "Triple-Twin" is shown in Fig. 4. (Solid line.) The frequency impedance characteristic of the coupling choke Lc is unimportant due to the relatively low value of the shunt resistance Rc. In any case its impedance would be a factor only at low frequencies. Likewise its distributed capacity is no appreciable shunt to the resistance Rc. It will be noted that there is no appreciable power loss at high frequencies, even those used in television, to the order of 50,000 cycles.

The low register is subject to the effectiveness of the by-pass condensers C_1 and C_2. However, the usual problem when employing high gain tubes, that of eliminating grid to plate coupling, is not troublesome as the high overall gain is divided between the two sections.

Table III: Circuit Constants

C1—Microfarads	2.0
C2—Microfarads	25
R1—Ohms (Push-Pull, 35)	70
R2—Ohms (Push-Pull, 135)	270
Rc—Ohms	12,500
Rg—Megohms	0.1
Lc—Henries (Min.) (D.C. resist. 200 ohms max.)	15
Zo—Ohms (Push-Pull 4000 ohms) (each side of centre tap)	4000

Operating Comparisons

It is well to point out the reasons for the high efficiency and sensitivity of the 295. For a given power output, when the input signal is confined to the negative portion of the Eg—Ip characteristics due to grid current limitation, as in triodes, the anode voltage to produce this output must be high to draw the electrons through the negative field produced by the heavily biased grid. In pentode operation, only the negative portion of the characteristic is used, but a positive auxiliary grid reduces space-charge effect, improving efficiency compared to a triode.

However, this auxiliary grid consumes energy and a cathode grid becomes necessary to reduce eccentric characteristic curvature caused by primary and secondary plate electrons. To overcome the shielding effect of this latter grid, a higher plate potential is required. Further reduction of efficiency is caused by the necessity of operating into a load approximately one-fifth of the internal impedance of the tube. The Triple-Twin operates at approximately zero bias, so that the signal swings equally into the positive and negative regions. This tube works into a load almost equal to its own impedance. With this arrangement the same power output can be obtained at considerably reduced plate voltage.

The power sensitivity of the "Triple-Twin" is high, due to the no-loss effects of direct coupling and the high gain in both the input and output sections. The effective grid area of the output section may be large, as the plate current is not limited by a strong negative field. This allows high amplification with a low plate impedance.

Tubes in Push-Pull

Push-pull operation of "Triple-Twin" tubes offers no difficulty. As will be noted (Fig. 2) the circuit consists merely of two single tube amplifiers as shown in Fig. 1, operated back to back. However, it differs from conventional push-pull circuits in that to maintain the cathodes of both tubes above ground potential a split secondary transformer together with the coupling resistors Rg, Rg is required.

As the distortion in a "Triple-Twin" amplifier is mainly second harmonic, push-pull operation offers a definite advantage in the cancellation of even harmonics. As will be seen from Fig. 3, an output of 14 watts may be obtained from a pair of these tubes operated in this manner at 250 volts plate potential, for an applied signal of 7½ volts RMS. It is interesting to note that an output of 10 watts may be obtained at a total harmonic distortion of less than 2½ per cent and with a 5½ volt (RMS) signal.

The fidelity of this push-pull arrangement is likewise excellent, following very closely the curve for a single tube, with some improvement in low frequency response (Fig. 4, dotted line).

It will readily be seen from the foregoing that considerable advantage accrues from the use of the "Triple-Twin Tube."

I—Output: High output at reduced plate voltages. II—Efficiency: High power for low plate dissipation. III—Sensitivity: Rated output for a 5 volt grid signal. IV—Fidelity: Frequency response flat within 2 d.b. from 30 cycles to 50,000 cycles. V—Economy: Elimination of amplifier stages and their coupling apparatus.

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

Rheostat leadership may be claimed by many, but we have it—

"Perfection" in name and performance.

Motion picture theatre owners and projectionists from Maine to California endorse our claim and know it's no idle boast.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Specialists

RHEOSTATS

THEY KEEP PACE

The developments of the past year show that NATIONAL PROJECTOR CARBONS constantly keep pace with the progress of the MOTION PICTURE INDUSTRY.

Pre-Cratered . . *High Intensity Carbons.*
New National SRA Carbons.
13.6mm x 22 inch . . *High Intensity Projector Carbons.*
85 Ampere 9 x 20 . . *"High-Low" White Flame Projector Carbons.*
Carbon Prices Reduced.

NATIONAL
PROJECTOR CARBONS
NATIONAL CARBON COMPANY, INC., Cleveland, Ohio
CARBON SALES DIVISION
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York, Pittsburgh, Chicago, San Francisco

STILL PREFERRED

Above All Others

MORE Miehling books have been sold to projectionists than any other . . . . There have been others since Miehling's book was brought out . . . . and some at a lower price . . . . but Miehling's still remains as the *only book written by a projectionist for projectionists* . . . . That it why it is so overwhelmingly popular.

In this book you will find a thoroughgoing explanation of the fundamentals of *all* sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.
519 pages . . . completely indexed

THIRTY-ONE chapters, each covering a phase of sound equipment operation, are thoroughly indexed in the back of the book, affording the projectionist full means of reference in case of trouble. The whole set-up of the book has been designed for leisurely reading or for quick use in a breakdown emergency.

ONE hundred and thirty-seven illustrations: diagrams, schematic drawings and photographs are scattered through the book, adjacent to connecting text. Continuity of text and picture is thus preserved throughout. A perfect book for projectionists.

Price $4.00, We Pay Postage

Mancall Publishing Corp.,
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $4.00.

Name ....
Address ....
City and State.............................
Position ....
Theatre ....

S.M.P.E. Establishes Museum on the West Coast

The Society of Motion Picture Engineers has established in the Los Angeles Museum a museum containing several thousand objects which show the evolution of the motion picture industry. This motion picture museum is managed by the Museum Committee of the society, under the chairmanship of Mr. E. Theisen.

The exhibits are arranged as far as possible in a chronological order, arranging them in such manner so the pioneers represented are given credit for the influence they exerted upon subsequent screen history. The labels on the exhibits are accurate, the authority for them being obtained from the Patent Office records and by referring to the pioneers making them. They are so labeled with a view in mind of a possible use of the exhibit for reference.

Among the exhibits represented are: Muybridge with his "Horse in Motion," experiments for Leland Stanford, various models of projectors, including Edison, Edison Exhibition Model, Pathe, Amet, Edengraph, Motiograph, Kinema-Kolor, etc. There is a collection of some three thousand stills, handbills, posters of the nickelodeon theaters, props used in pictures, miniatures and photographs of prominent people.

One exhibit that represents about six years' work is a collection of authentic specimens of film made by the various pioneers. These specimens are a frame or two in length and are bound between glass for preservation. These actual specimens of film show in a concise manner the evolution of the industry. Accompanying each specimen is an historical notation on the pioneer making the specimen.

There are about twelve hundred specimens in this collection and among them can be seen films of any width from four millimeters up to four inches representing various attempts to establish other than the thirty-five millimeter width. There are some two hundred different color attempts recorded. This collection includes, besides color and the various width attempts, sound, third dimension, processes and outstanding pictures; in fact, everything that is made on film, including the first piece of film made on the celluloid supplied by George Eastman to Edison in 1889 and transparent paper used prior to the advent of celluloid.

Mrs. Alice Herbert, the widow of the late Thomas H. Ince, has deposited at the museum a collection of ninety-four albums, containing the complete collection of synopses of the pictures directed by Ince. Accompanying these synopses is a complete set of stills of the pictures. This dates back to 1919, when Mr. Ince first contacted with motion pictures with Biograph.

Another interesting collection on exhibit was made by David Horsley in 1920. This is a collection of famous stars of 1915 to 1920. They are hand-colored transparencies. Mr. Horsley was an outstanding independent producer. He formed the Centaur and Nester Film Companies, also assisting in the formation of Universal.

The Los Angeles Museum in which the motion picture museum is housed is maintained by the county and is open seven days a week. It occupies a pretentious building in Exhibition Park. There are about five hundred visitors there daily.

Motion Picture Film in the Making

(*Continued from page* 7)

quantities to suspend the emulsions' silver salts evenly on the film base—but gelatine for photography must be chemically purer than that used for food. To make photographic gelatine, patient processes of chemical treatment in hundreds of covered concrete tanks prepare hide remnants for cooking. The gelatine, after washings, boilings, filtration, solidification, blending and action to remove any accidental metal content, is ready to join the silver nitrate in the emulsion department.

The making of light-sensitive emulsions—the portion of film which actually records the picture—is a highly diversified and extremely delicate process. The photographic industry, in fifty years of experience, has turned an art depending on chance and mood into an exact science. The genius of pioneering emulsion makers, combined with the manufacturing talent of picked chemical technologists and combined with the large production which the photographic industry has reached — for size and therefore continuity of operation is an important factor in insuring uniformity of photographic materials—has established the quality of this delicate substance known as photographic film on a level where the users of film need hardly give a thought to its quality.

The news man "shoots" racing aeroplanes from a precarious perch; the studio man makes softly moulded close-ups with exquisite care; the laboratory man produces several hundred prints of a feature. All these activities require types of film that will respond faithfully to the technicians' skill, every time, year after year.

Control Methods

Chemical and physical control of silver salt crystals, together with the addition of extraneous materials, makes emulsions "fast" or "slow," "contrasty" or "long-scale," sensitive to light from various parts of the spectrum, and photographically responsive in still other significant ways. This control in emulsion making is responsible for the various types of motion picture film known within the industry.

For atmospheric control and other purposes, this typical film manufactory maintains the largest refrigeration plant in the world. Projectionists may be interested to see in the next issue of THE MOTION PICTURE PROJECTIONIST how the cold that is the product of this refrigeration plant, and the cleanliness that is a product of many precautions and activities, are as important a "raw material" of motion picture film as the cotton, the saltpeter, the sulphur, the camphor, the wood alcohol, the hides, the silver and the potassium bromide.

(*To be continued*)

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of

MOTION PICTURE PROJECTIONIST,

published Monthly at New York, N. Y., for April 1, 1932,

STATE OF NEW YORK }
COUNTY OF NEW YORK } ss.:

Before me, a notary public, in and for the State and county aforesaid, personally appeared Charles E. Brownell, who, having been duly sworn according to law, deposes and says that he is the Editor of MOTION PICTURE PROJECTIONIST, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and regulations, printed on the reverse of this form, to wit:

1. That the names and address of the publisher, editor, managing editor and business manager are: Publisher, Mancall Publishing Corp., 7 West 44th St., New York City; Editor, Charles E. Brownell, 7 West 44th St., New York City; Managing Editor, none. Business Manager, Boone Mancall, 7 West 44th St., New York City.

2. That the owners are Mancall Publishing Corporation, 7 West 44th St., New York City; Olga Mancall, 323 West 90th St., New York City; Boone Mancall, 7 West 44th St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is . . . (This information is required from daily publications only.)

CHARLES E. BROWNELL,
Editor.

Sworn to and subscribed before me this 19th day of March, 1932.

JACOB SELIGMAN,
Notary Public.

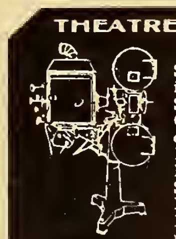
[Seal] (My commission expires March 30, 1932.)

HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.
H&C INC.



THEATRE EQUIPMENT
NEW AND USED

Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.

Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.

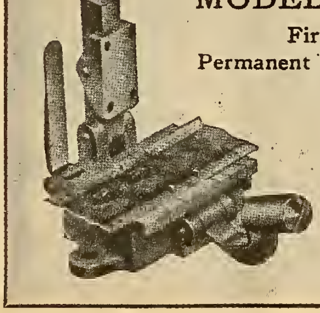
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.

Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO., 844 So. Wabash, Chicago.

INSURE YOUR JOB!
Study F. H. Richardson's
Handbook of Projection

Three volumes containing over 1,400 pages of vital knowledge with question and answer index. Every projectionist needs this authoritative guide. See your local theatre dealer or send for full details.

CHALMERS PUB. CO.
516 Fifth Ave., N. Y.



Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film
Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers

Good Projection Requires Good Rectification

M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes, then the other two, as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP.
New and Wilsey Sts.
Newark New Jersey

General Plans for I.A. Convention Approved

Fred J. Dempsey, secretary-treasurer of the International Alliance of Theatrical Stage Employees and Moving Picture Operators of the United States and Canada, visited Columbus, Ohio, during the past week and conferred with the local committee, which is planning details of the Thirty-first Bi-Annual International Convention, scheduled for Columbus June 6th to 11th.

Mr. Dempsey approved general plans which have been made by a committee of seven members of Columbus stage hands and moving picture machine operators, and went on a western trip, planning to return to his office in New York within a few days.

Charles Pratt, who is chairman of the local arrangements committee, announced this week that all business sessions are to be held at Memorial Hall, a centrally located auditorium of 5,000 seats, and that evening sessions may be necessary to work off all the matters demanding attention. Starting on Thursday, June 2d, district conferences will be held. These will all be worked off by the time of the opening of the main convention on June 6th.

Columbus is a city of around 400,000 population, with every facility for amusement, and it is the aim of the convention committee to see that all are treated royally.

NO MORE CELL WORRIES

●

TELEPHOTO PHOTOELECTRIC CELLS

Designed of tested materials by master craftsmen, Telephoto cells have achieved ultimate present-day perfection. Sensitive to the highest degree, they reduce the amount of amplification required for tonal reproduction obviating to a remarkable extent the possibility of distortion.

Made in all types and shapes

TELEPHOTO CELLS ARE STANDARD EQUIPMENT IN USE BY LEADING SOUND HEAD MANUFACTURERS.

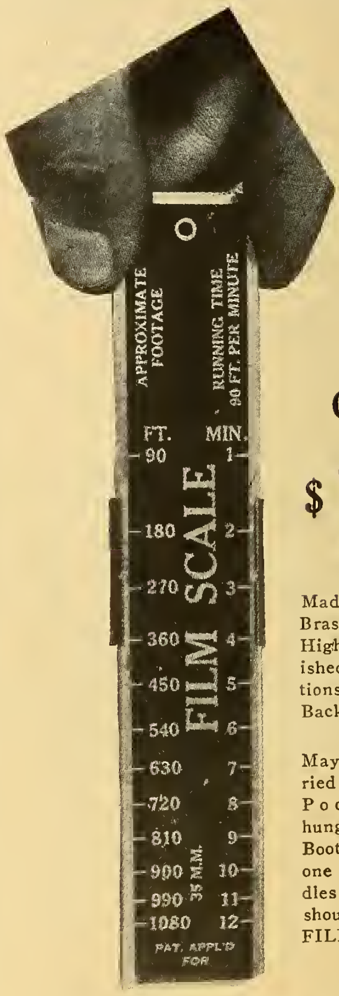
Pamphlet on request

Telephoto & Television Corp.
133-135 West 19th Street
New York

Simple Accurate Essential

35 M. M. FILM SCALE

. . . Belongs in your TOOL KIT



Only $1.00

Made of heavy Brass, Etched, Highly Polished Graduations on Black Background.

May be carried in a Vest Pocket or hung in the Booth. Every one who handles FILM should have a FILM SCALE.

GAUGE your own running time. FILM SCALE will tell you with the utmost ACCURACY the exact length of the film on the reel—it will tell you with perfect precision the length of time necessary to run that reel through the projector. No more guesswork.

Every PROJECTIONIST should own one and save a load of guesswork and trouble.

Write for Catalog

Fill in COUPON—pin a dollar to it

UTILITY SALES CO.
7 West 44th Street, New York City, N. Y.

Enclosed find $1.00 for one FILM SCALE and DIRECTIONS.

Name ....
Address ....
City........................ State................
THEATRE ....

Come In . . .

and bring along your troubles!

This is a standing invitation to all Projectionists and Projection Engineers. Come in and get better acquainted with National Service. If you have troubles, bring them along for discussion. Discuss the latest mechanical developments for perfect sight and sound reproduction, while you inspect them first hand in our display rooms. Verify your impressions by a close-up examination of what you have been reading about. There's always something new to see and talk about at National, and you're always welcome.

National Service meets every mechanical problem of theatre operation

NATIONAL THEATRE SUPPLY COMPANY

YOUR LOGICAL SUPPLY SOURCE

$2.00

SERVICING PROJECTION EQUIPMENT
SERVICING PROJECTION EQUIPMENT

SIMPLE
QUICK

This book is not theory and it isn't history. It is just what its name implies: a practical treatment of common and uncommon projection room troubles and their quick remedies. With it, on your work bench or in your work jacket, you are master of your equipment. Throw the fear of a 'dark screen' out of your mind — this tremendous book will save you from every theatening projection trouble.

Be
the BOSS !

The projectionist in the picture *MIGHT* be you. Does he look desperate . . . Does he search tremblingly for the trouble while the screen is dark and the audience stamps, whistles and shouts for the picture?

Not he. With sure fingers and calm, unhurried mind he has gone straight to the cause of the breakdown and he fixes it in a moment. *He is the boss.*

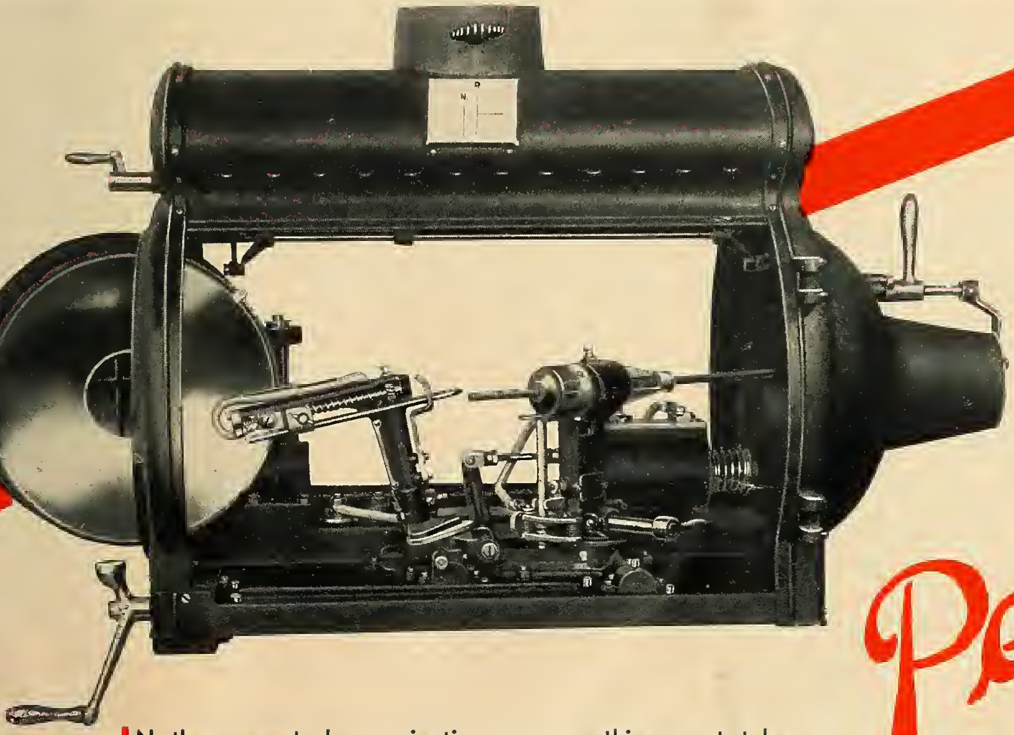
He owns a copy of this book. *YOU* can be like him in an emergency.

Get a copy of this valuable book and Be Boss!

Order Your Copy Today From

MOTION PICTURE PROJECTIONIST, 7 West 44th Street, New York City

MOTION PICTURE PROJECTIONIST



LIBRARY OF CONGRESS

Peerless

"The Super Reflector Arc Lamp"

IN the present day projection room, nothing must take away from the projectionist the time required for his attention to the many added details of modern booth routine.

Never for want of time should he find it necessary to miss this or that, or let some duty go until later. Everything must "click" in rotation.

By their proven ability to stand up and deliver uncomplainingly, with an absolute minimum amount of attention, Peerless Reflector Arc Lamps have won their enviable position of "THE PREFERRED" among the craftsmen of the projection room.

Is further proof of superiority necessary?

The Choice of
CRAFTSMEN

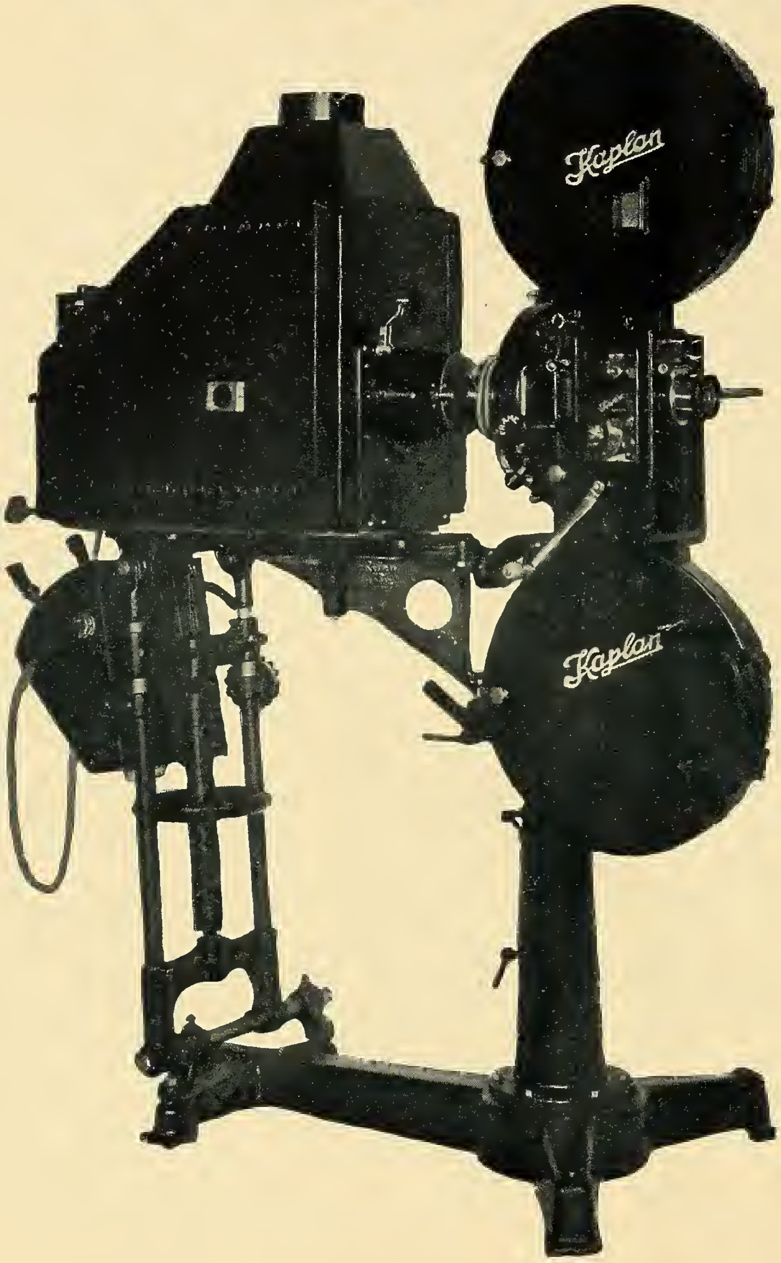
J. E. McAULEY MANUFACTURING COMPANY
552-54 West Adams Street - Chicago, Illinois

Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.*
Editorial and Advertising Offices 7 West 44th Street, New York City.
Entered at New York Post Office as second class matter, October 25, 1927.

Vol. 5 • No. 8 • June, 1932

31ST I.A.T.S.E. CONVENTION *in* COLUMBUS, O.

Kaplan



PROJECTOR

The Kaplan Projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

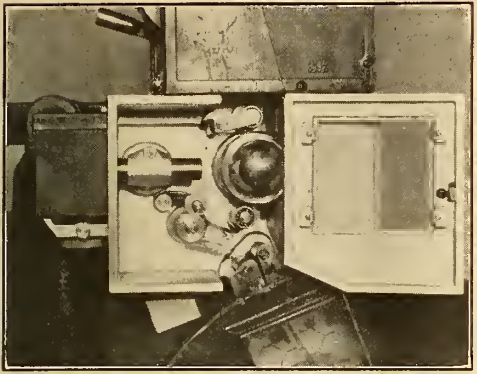
An Engineering Product

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue ·:· ·:· New York City

A Recently Developed Sound Head

Proven Truly Good!

Built for Simplex, Powers, Kaplan and Superior Projectors.



Complete sound equipment:
Sound Heads
Amplifiers
Speakers
Motors
Screens
Projectors

LE ROY MASTER MODEL SOUND HEADS

Are the least expensive in view of the many years of trouble-proof service they will give the exhibitor.

One hundred positions for wear adjustment of the front edge film guide.

Film rollers are the highest grade ball-bearing type.

Rear edge film guides are ball-bearing mounted. (Cannot be worn out.)

Lighted interior—window in door which opens to right.

Film sprocket guide roller locks out of the way for easy threading.

Photo-electric cell is accessible from both front and rear. (Completely housed in.)

Photo-electric cell located close to film, making light loss very low, with a corresponding greater volume from amplifier.

Optical system—very finest made—precision lens and highly corrected slit; although projecting maximum amount of light obtainable, will clearly reproduce 8,000 cycles and over.

COMPARE THESE FEATURES WITH THOSE OF OTHER SOUND HEADS—THEN BUY LE ROY'S.

Our sound head for the Holmes Portable Projector is light, compact and durable. Built fully up to the high standards of our other equipment. Positive film drive over curved sound gate!

LE ROY Sound Equipment CORP.

421 Lyell Ave. Rochester, N. Y.
Affiliated with Octo Engineering Ass'n, Inc.

Designed and manufactured by engineers. Used in many theatres. Enthusiastically endorsed everywhere. The result of years of experience in public address and amplification work plus actual experience in designing and building successful theatre sound units. A Guaranteed product.

WORTHY OF THE ATTENTION AND ENDORSEMENT OF EVERY PROJECTIONIST

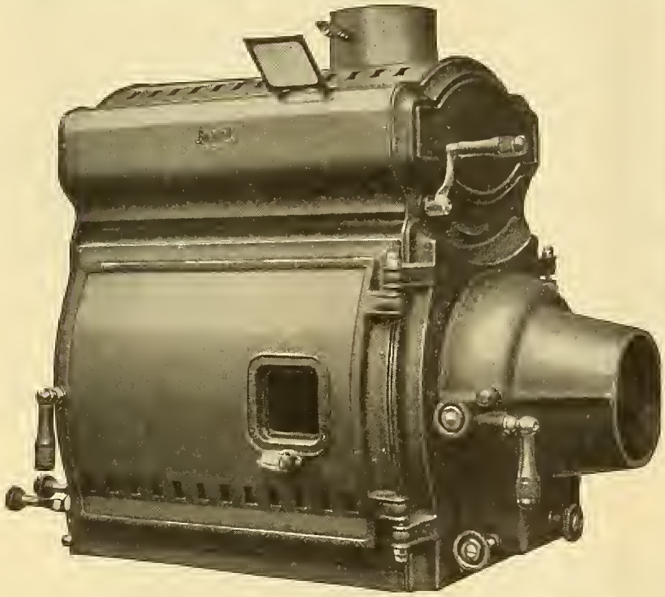
CONSISTENTLY
EXCELLENT SCREEN
ILLUMINATION

TROUBLE FREE
OPERATION

LOW MAINTENANCE
COST
are synonymous with

Brenkert

SUPER HIGH INTENSITY
PROJECTION LAMPS



No Screen too Large—No Film too Dense
USED BY LARGE CIRCUIT AND INDEPENDENT
THEATRES FROM COAST TO COAST

Ask Any User

A Brenkert PRODUCT

Write for Literature

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

How About a Modest Installation in Your Projection Room?

AN automatic fire hero was viewed recently by delegates at the annual convention of the National Fire Protection Association in Atlantic City. The hero is a system of apparatus which plays the part of the man who keeps cool and knows just what to do in an emergency.

The system serves as a fire alarm that avoids alarming anybody. It automatically detects a fire and then forces the fire to announce itself in a human voice which calmly warns people, instructs them how to leave a building and starts a band playing to help them march out quietly.

The apparatus, publicly demonstrated for the first time, was exhibited at the Sea Side Hotel near where the Association's convention met. It has just been perfected by engineers of the Western Electric Company working in conjunction with the Garrison fire detecting system. Besides the unusual technical features of the apparatus, the use of a voice and a band instead of the traditional fire gong is based on the findings of modern psychology as to the way people react both to emergencies and to different kinds of sound.

By means of electrical devices, the system combines an automatic fire detector with a music reproducer which is connected to loudspeakers. In the demonstration at Atlantic City, a small flame is placed near the fire detector. A few seconds later the detector responds in three ways. It sends an alarm straight to the fire house, directing the firemen to the side of the building nearest the fire, while in front of the building itself an arrangement of lights shows them in what particular part of it the fire is located. At the same instant, the music reproducer commences playing and is heard over loudspeakers. Thirdly, green arrows light up, pointing out the correct route for exit.

The record, designed in this case for use in a school, begins with a flare of trumpets, followed by a distant siren. Then a calm but commanding voice says: "There is a fire emergency but no immediate danger. You must leave the building. You are drilled in this and know just what to do. Leave your hats and coats, take your places in line. Steady now, don't rush. Follow the green arrows." A brass band strikes up a martial air and the sound of approaching sirens is heard through the music.

Everything in the record has a definite purpose. The band piece was chosen for its strong marching rhythm. The siren is injected to accustom the children to it in drill so that they will not be frightened when they hear the real thing for the first time. Fire chiefs recommended the command to abandon hats and coats as experience shows they are likely to be dropped, causing others in the line to stumble.

The automatic fire detector uses special wiring which is sensitive to heat. The core is a fusible alloy enclosed in a steel sheath which is slit along its entire length. At 160 degrees Fahrenheit the alloy melts and expands forcibly. It spurts through the slit and, making contact with an outer metal sheath, causes a short circuit that sets off the alarm. In actual installation, this wiring is placed throughout a building and a very small current, enough to spring the alarm, is kept flowing through it.

In the Western Electric Sound System that is used, the music reproducer is associated with an amplifier which may be connected to loudspeakers of any size placed in any number of rooms, hallways and auditoriums. The apparatus is "electrically supervised." A small current, about equal to that consumed by an ordinary 60 watt electric light bulb, keeps the amplifier tubes warm and ready to operate instantly, and also notifies the local technician should the slightest misadjustment occur. All the vital apparatus in the system is protected in a fireproof vault.

"The bell or gong of the traditional fire alarm," said William Lindsey, president of Garrison Fire Detecting System, "actually alarms and frightens people, but does not tell them what to do. Modern study of the effect of sound shows that [illegible]rous sounds of that kind even in the absence of an [illegible]rgency tend to make people feel excited and lose th[illegible] heads."

MOTION PICTURE PROJECTIONIST

June, 1932 Vol. 5, No. 8

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Boone Mancall

Editorial & Advertising Office
7 West 44th St.
New York City.

ALLIED PRINTING TRADES UNION LABEL COUNCIL NEW YORK CITY 273

RCA Demonstrates Television To Set Manufacturers

Experimental work in television reception was demonstrated recently to its licensees by the Radio Corporation of America. About one hundred executives and engineers, representing approximately fifty radio set and radio tube manufacturers, attended the demonstration.

Although continued progress has been made with television, this development is still in the laboratory stage. The demonstration was held for the purpose of showing RCA licensees the present status of research and development being carried on by the RCA and its subsidiary companies in this field.

Radio engineers stated that television can best be brought into practical application on its own band of ultra short waves, thereby providing ultimately a service additional to the established service of sound broadcasting. Much work remains to be done toward the improvement of receiving equipment and the creation of transmission facilities for practical television broadcasting.

THE INDUSTRY NAMED THEM BEFORE THEY WERE OUT

EVEN before Eastman Sound Film Patches were ready for sale in quantity, the industry had named them "bloopers," referring to the unpleasant sound which they eliminated from sound film projection.

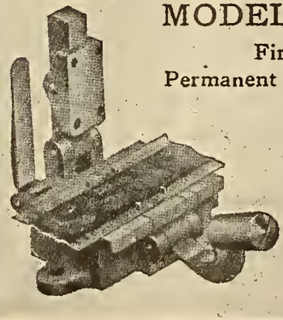
Now they and their special registration block are standard equipment in hundreds of theatres. They are almost inaudible in projection, obscure a minimum of the sound track, and reduce splicing to a clean, quick, satisfactory job.

Prices: Eastman Sound Film Patches, per thousand, $5; Eastman Sound Film Patcher (registration block), $4.25. Eastman Kodak Company. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN
Sound Film Patches

Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22



First-Class Results on New or Old Film
Permanent Gauge No Adjusting
FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers

Mutual Dependence

THE remarkable technical advance of the motion picture projectionist—now fully recognized and acknowledged—has been an outstanding factor in the growth of the motion picture industry.

AS the oldest and largest manufacturers in the world of motion picture equipment we wish to express our appreciation of the cooperation we have received for many years from projectionists throughout the world. The progress we have made—the success of our products—has been largely due to the contacts we have had with projectionists and to our realization of their requirements. Leadership is the result of such understanding.

THE craftsmen and the makers of craft equipment cannot avoid a mutual dependence. As we have created and maintained projector standards upon which projectionists have relied for many years, we ask for a continuation of their support. In return we pledge ourselves to take a constant and experienced interest in all the many phases of their technical problems.

Simplex
The International Projector

INTERNATIONAL PROJECTOR
CORPORATION

90 GOLD STREET NEW YORK, N. Y.

As The EDITOR *Sees* IT

¶ *The Columbus Convention*

EVEN at the moment of our going to press, officers and delegates from all over the United States and Canada are headed in automobiles, railroad trains and even in that ultra-modern vehicle, the airplane, for Columbus, Ohio, to attend the Thirty-first Biennial Convention of the International Alliance.

It is a solemn occasion. The entire continent, and the world, in fact, is in the throes of a severe crisis. Union Labor has not been excepted. Realizing the gravity of the problems confronting them, the officers and delegates of the Alliance are in a serious mood . . . on the successful solution of the questions confronting them may well depend the ultimate happiness and security of its membership.

Knowing, as we do, the high calibre of the officers and men comprising the I. A., we are confident that the decisions which are to be made at Columbus will not only reflect to the enduring credit of the Society, but that they will be conducive to the betterment and the welfare of the membership as a whole.

On the part of this publication, and on the part of its readers—most of whom are members of the Alliance—we extend to the officers and delegates attending the Thirty-first Biennial Convention our hearty good wishes.

¶ *Once in a Blue Moon*

IT is evening—the evening of the third day of the S.M.P.E. Spring Meeting. The scene is the theatre of the Wardman Park Hotel at Washington. The little auditorium is filled to capacity.

The gathering is interesting and impressive . . . engineers of national and international reputation . . . alert and ambitious youngsters who hope to follow in their elders' footsteps . . . a sprinkling of loyal wives who have accompanied their husbands to the convention and, though probably bored with the technicalities of the occasion, are determined to "sit it out" . . . and a goodly contingent of uninvited but nevertheless welcome hotel guests, who through motives of idleness, curiosity, or the hope of a free movie, have added their numbers to swell the crowd.

A spirit of restlessness pervades the audience . . . the presentation of papers has carried over into the evening. The guests stir in their chairs and whisper to one another, here and there someone stifles a yawn —even the keen-edged enthusiasm of the engineers has become somewhat dulled—they have been listening to and participating in papers and discussion from early morning.

The speaker of the moment concludes his address—an excellent one, deserving of delivery under more favorable circumstances—and descends from the stage. There is a flurry of handclapping . . . a young lady in evening costume awakens and looks sheepishly at her partner. A buzz of conversation sweeps through the assemblage. The audience becomes hopeful—this must be the end of the papers program. Surely it cannot continue all night! And now for the movies—

But no!—A young man walks quickly down the aisle and takes his place at the speaker's desk. His name is Dimmick. He is associated with the Photophone Division of the RCA Victor Company. The audience inspects him with polite indifference—the hour is growing late—just another speaker and another address.

A slide is thrown upon the screen. The speaker's voice is heard, low, well-articulated, but almost a monotone . . . "A new wide-range system of recording and reproduction for sound-on-film." The audience looks politely skeptical, and the hotel guest contingent returns to its contemplation of free movies to come. He can't last more than twenty minutes, and then—

The paper ends abruptly! A demonstration! The lights in the auditorium are dimmed. A faint blue light is projected to the screen, and, reflecting into the audience, it pervades the seating area like the haze of a Whistler nocturne. . . . A good setting, considering property limitations.

The whirr of a projector in starting is heard and the demonstration is on—a selection from the *Grand Canyon Suite*. A fanfare of brass, and the heavy, insistent beating of drums. The silvery tinkle of triangles, high in the upper register, sweet, well-rounded and clear. Hardened skeptics look at each other in amazement. The selection ends in a burst of enthusiastic applause. Another milestone has been reached on the road to perfection in sound reproduction!

To say that the engineers of Photophone are deserving of the gratitude of the theatre-going public, is putting it mildly. It is not difficult to do a thing well. All that it requires is a little conscientious effort. But to do a thing exceptionally well is something of an accomplishment. . . . And Photophone's new "high fidelity" system (call it what you will, it has not yet been officially named) falls by far and away in the latter category.

It brings forcibly to mind the words of Junius: "The heart to conceive, the understanding to direct, the hand to execute." It is the *ne plus ultra*—the thing that happens once in a blue moon.

CHARLES E. BROWNELL.

All Roads Lead to Columbus

By CHARLES E. BROWNELL

IT may be thought by the casual reader that the only purpose of our heading is to serve as a lively caption, but it is literally true—we looked it up.

There are the Pennsylvania Lines West; Pittsburgh Division, Indianapolis Division, Little Miami Division, and Toledo Division. There are the Hocking Valley, the Cleveland, Akron & Columbus, the Norfolk & Western, the Toledo & Ohio Central and the B & O. Some of these may be coal roads, but in these days of "repression" even the lowly brakebeam is a godsend.

There are eleven electric railways operating "out" of Columbus—and we can even tell you how many cows there are to the square foot in the environs.

Why, do you know, back in the old, Pre-Volstead days, Columbus was a center for the manufacture of malt liquors?—But, of course, this is *all over* now.

And Furthermore

Columbus is a residential city, a center of well-constructed homes. It ranks twelfth in shoe manufacturing. It produces patent medicines, paint and varnish, confectionery, brass and bronze, tin and sheet iron, steam railroad chemicals, and marble and stone. It possesses one hundred and eighty-five churches of all denominations. It has a new Elks Home, not to mention a superb Masonic Temple, an Athletic Club and a fine Knights of Columbus Home. Incidentally, it is the capital of the state.

You will have to admit that, when it comes to Columbus, we know our Christophers—there is nothing like a good old Chamber of Commerce throwaway, when it comes to giving the home town a boost. But enough of statistics!

Columbus, as you are all aware, is to be the scene of the approaching I. A. Convention. For this purpose, at least a thousand men are converging on the city from almost every town of any size in the United States and Canada. There have been other conventions, many of them, in other and happier times, but this one is to be strictly business—serious business.

This is not our personal opinion. It was expressed to us the other day in the course of an interview with Mr. William C. Elliott, the International President of the Alliance. . . . And Mr. Elliott knows whereof he speaks. Behind his genial smile and charming personality there is a dogged determination to "put the Alliance across."

These are dark days, dark days for everyone, and the "union man" is no exception. There is probably not a man or a woman in the country today who has not, during the past year or more, questioned the future with misgivings. It is a time, as never before, when able and intelligent leadership is needed, and the words of President Elliott are the words of a man and a leader: "Tell the boys that the Columbus Convention is a serious matter. It is a time for careful and constructive thought. The comedian has seen his day, and that day is past. The officers and delegates are going to Columbus with one thought in mind—the present and future welfare of every member of the International Alliance."

WILLIAM C. ELLIOTT
Int. President I. A. T. S. E.

The International President

To those who have never met Mr. Elliott, the first encounter is not only a privilege but a revelation. A man of powerful physique and commanding figure; his genial, welcoming smile immediately puts the visitor at his ease. But it is not a smile that makes one forget the man. One instinctively feels the powerful personality that presides over the destiny of a great organization. The executive is amply evident in the personality of the man.

For those who are unacquainted with Mr. Elliott's history, it may not be amiss to pass briefly over the highlights of his remarkable career.

The present International President was born near Lexington, Ky. He is now in his fifty-first year. One might say that he has grown up in the show business, for, when still a youngster attending school, he secured a part-time job as property clearer in the Grand Opera House, Cincinnati. This city was the scene of his operations for several years, always associated with the theatre, and it was here that he became affiliated with the union labor movement as a member of the Cincinnati stage employes' local.

In 1904, imbued with the lure for travel, Mr. Elliott joined Dockstader's Minstrels and served in the capacity of property man for the troupe for about a year. In 1905 he made a connection with B. C. Whitney's musical show, "The Isle of Spice," and remained with the Whitney company as electrician for a period of three years.

For the twenty years following Mr. Elliott was on the road, serving with the Shuberts, Richard Mansfield, Maude Adams, Erlanger and others.

Rise to Leadership

Returning to Cincinnati after this period, he served in the capacity of electrician in various theatres of the city until 1922, when he was elected fifth vice-president of the International Alliance. Since this time his rise to national prominence as a union leader has been steady and rapid.

As international president, it will be Mr. Elliott's duty to welcome Governor White of Ohio, who is scheduled to make the opening address of the Convention. General plans for the gathering have been largely in the hands of Columbus Locals 12 and 386.

The present officers of the International Alliance, in addition to Mr. Elliott, are Fred J. Dempsey, General Secretary-Treasurer; John P. Nick, First Vice-President; William P. Covert, Second Vice-President; William J. Harrer, Third Vice-President; Joseph C. Cambell, Fourth Vice-President; William T. Madigan, Fifth Vice-President; Floyd M. Billingsley, Sixth Vice-President; Harland Holmden, Seventh Vice-President, and Trustees, William C. Scanlan, Walter S. Croft and John McCarroll. The Organizers are: Representatives E. J. Tinney, W. P. Roual, W. A. Dillon, W. S. Croft, C. A. Weston, and O. M. Jacobson. The three Delegates to the American Federation of Labor are: Thomas F. Malloy, James J. Burke and Fred J. Dempsey.

The last previous convention of the International Alliance was held at Los Angeles, in June, 1930. Among the notable guests on this occasion were Governor C. C. Young of California, whose speech of welcome officially opened the convention, and the Honorable John C. Porter, Mayor of Los Angeles, who tendered to the members present the mythical keys of the city.

The Power Pack in Theory and Practice

By ALBERT PREISMAN

Most of us can doubtless recall the elaborate motor generator and battery installations which were required with the early types of theatre sound equipment. Such installations, through the application of the power pack, have been greatly simplified during the past few years. In the article which follows, Mr. Preisman considers underlying principles of the power pack and the various applications to which it is susceptive. The author is a member of the teaching staff of RCA Institutes.—THE EDITOR.

ARCHAEOLOGISTS, by digging assiduously into the earth, uncover city under city of ancient times, and bring to light new facts of long known peoples and old facts of newly discovered vanished races. A cross section of the surface strata of the earth thus becomes a sort of museum, in which, as we pass from the top to the bottom, we find successive civilizations until we reach prehistoric times and beyond, where a merciful obscurity hides from the garish light of day the sad results of the disinterested and unmoral forces of nature.

Many of us could pursue a similar course in our attics, and, in particular, bring to light relics of bygone radio days, down to its very dawn, when the articles of commerce were things only to be bought and sold, and not sources of entertainment, sermons, and lessons on pseudo science. If we were to follow such an archaeological career, we would be particularly struck by the development of the power pack, the source of power for the set.

Reason for Existence

The raison d'etre for the power pack is that the vacuum tubes require direct current for their operation, whereas alternating current is almost universally in use. Furthermore, power is required at different voltages for the component parts of the tube, so that even where a direct current supply is available, suitable means must be employed to furnish it to the set at the different voltages required by the tubes.

Fortunately, there are means at hand for taking alternating current at some fixed voltage—say 110 volts—and converting it into direct current at various voltages, as well as alternating current at various voltages. The methods employed will form the subject material of this article.

The component parts of a power pack are, therefore, the following:

1. A device for transforming the A.C. supply into alternating currents at different voltages as required. This device is the well-known transformer, and is composed of two or more windings on a laminated steel core. It has no moving parts, and operates at a relatively high efficiency.
2. A device for converting (rectifying) the A.C. into D.C. For this purpose there are several means available, such as the two electrode vacuum tube, gaseous conductor tube, dry disc rectifiers, mercury arc rectifier, and mercury vapor tube.
3. A means for smoothing out the pulsating D.C. into steady or continuous D.C. This is known as the filter, and almost invariably consists of combinations of inductances (choke coils) and condensers.
4. Finally, a means for obtaining various D.C. voltages from the A.C. rectified and filtered by the above devices. This is usually a resistor which is tapped at various points, and thus functions as a kind of multiple potentiometer to furnish the various D.C. voltages required. This unit is often called a "voltage divider" and also a "bleeder" resistor.

The Power Transformer

Let us now study these components in somewhat greater detail. As mentioned above, the transformer consists of a closed or endless laminated steel core, around which are wound various coils of wire. Figure 1 illustrates a transformer. "A" is the laminated steel core, and "B," "C," "D" and "E" are the various windings. In particular, "E" is a winding whose center turn has a tap brought out; i.e., a connection can be made to its center turn. "E" is, therefore, equivalent to two windings of half the number of turns joined in series.

Let us suppose for the moment that winding "B" is connected to a source of A.C. An alternating current will flow through B, and, by the well-known principles of magnetic induction, set up an alternating magnetic flux in the core "A." By another well-known principle, that of electromagnetic induction, this *alternating* magnetic flux will induce an *alternating* voltage in the coil "B," and this induced voltage will be opposite to and nearly equal to the impressed line voltage. Due to this fact, the current in "B" will be very small.

Induced Voltage

However, the same alternating flux is threading through coils "C," "D" and "E" and will, by the same principle, induce alternating voltages in them. The voltage induced depends upon the amount of flux and the number of turns through which the flux is threading. Now we know that the flux cannot induce in "B" a voltage exceeding the impressed line voltage, otherwise current would flow from the transformer into the supply source, and this is impossible, since the transformer is assumed not to be receiving energy from any other source so that the Principle of the Conservation of Energy would be violated. Therefore, the amount of alternating flux set up is just sufficient to induce a counter voltage in "B" almost, but not quite, equal to the impressed line voltage.

If winding "C" or "D" or "E" has the same number of turns as "B," the same voltage will be induced in it as in "B." The only difference is that in these latter coils, this induced voltage is the only voltage acting in the coil, whereas in "B" we have the somewhat greater and consequently

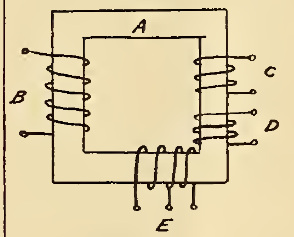


Figure 1.

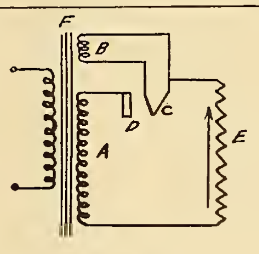


Figure 2.

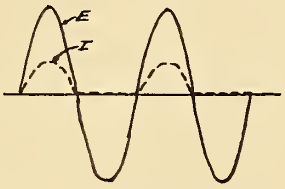


Figure 3.

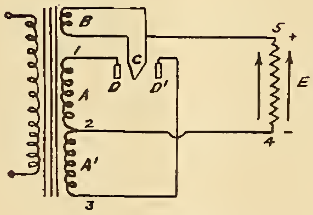


Figure 4.

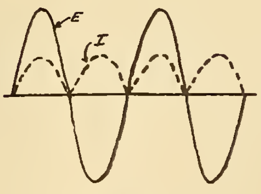


Figure 5.

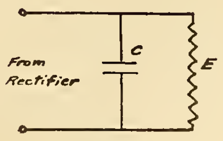


Figure 6.

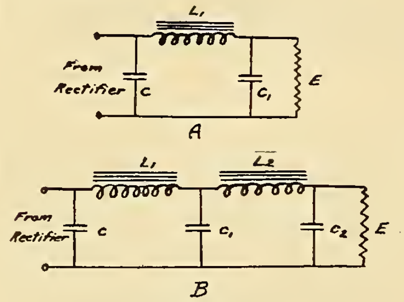


Figure 7.

overpowering line voltage acting, and this line voltage conceals the presence of the somewhat smaller counter voltage induced in "B."

If winding "C," for instance, has half the number of turns of "B," the alternating flux in the core will induce in "C" one-half the voltage induced in "B," or therefore approximately one-half the line voltage. If another winding, "D," for instance, has twice the number of turns as "B," the same alternating flux will induce in it approximately twice the line voltage. Winding "B" is known as the primary winding because energy is coming into it from the source. The other windings are known as secondary windings because energy will flow out of them into any connected load. It is evident from the above that the voltage induced in a secondary winding has the same ratio to the primary voltage as the secondary turns have to the primary turns. In symbols, this is

$$\frac{Es}{Ep} = \frac{Ns}{Np}$$

where Es is the secondary voltage
Ep is the primary voltage
Ns is the secondary number of turns
Np is the primary number of turns.

Now let us examine the functioning of this transformer when a load is connected to a secondary winding. Suppose this latter be "C," and furthermore let us suppose "C" has half the number of turns of "B." As current flows from "C" into the load, this current tends to set up a magnetic flux of its own in the core, and the tendency is proportional to the product of the secondary current by the secondary turns, or more briefly, to the ampere turns. This secondary flux interacts with the original primary flux in such a manner as to allow the supply source to send into the primary sufficient additional current to balance the magnetic effect of the secondary current.

Since the primary in this example is to have twice the number of turns of the secondary, the additional current it requires to balance the secondary current need be only half the value of the latter, in order to produce the same number of ampere turns. Now, remembering that the voltage induced in the secondary is due to the same flux as that producing the counter voltage in the primary, and the latter voltage is opposite to the impressed line voltage, it is evident that the secondary voltage is opposite to the line voltage, too. Therefore, the secondary current will be opposite to the above, additional primary current—since each current is in the same direction as its respective voltage—and that is why the primary can draw additional current in just the proper direction to balance the magnetic effects of the secondary current.

From the above example it will be noted that primary and secondary currents (Ip and Is, respectively) are inversely proportional to the turns ratio; i.e.,

$$\frac{Ip}{Is} = \frac{Ns}{Np}$$

This means that if a higher voltage is induced in a secondary winding, a greater current will flow in the primary for a given current drawn from the secondary. If the transformer has several secondaries, as in Figure 1, the primary will draw sufficient current from the A.C. source to balance the magnetic effects of all the secondaries. (The reader must bear in mind that this primary current is over and above the original magnetizing current flowing in the primary when no current was drawn from any of the secondaries.)

Application of Rectifier

The rectifier most often used is the two electrode vacuum tube. Figure 2 shows its parts and connection to a circuit. "C" is the filament, and "D" is the plate of the tube. "F" is the transformer supplying the alternating current and "A" is a secondary winding whose function it is to send current through "C" and heat it hot enough to cause it to emit electrons. The plate or anode, "D" of the tube is connected to one end of a secondary winding "A" and the other end of "A" is connected to the load "E" as shown. An inspection of this diagram shows that the rectifier tube is really connected in series between the load "E" and the secondary winding "A." ("B" is merely a source of heating potential for the filament "C".)

Since "C" is emitting electrons, but plate "D" is not, because it is not heated, it is evident that electrons can only move in the direction from "C" to "D." That means that the direction of the electron flow through the load "E" can only be in the direction indicated by the arrow, so that when the voltage in "A" reverses, and tries to send electrons from "D" to "C" and thence downward through "E,", the current flow is stopped by the tube. The latter thus acts in a manner similar to a check valve in a steam pipe system, and allows electricity to flow only in one direction.

From the above it is evident that current will flow only during every other half cycle, and no current will flow during the intermediate half cycles. In other words, only one-half wave of each cycle is rectified, so that this rectifier is known as half-wave rectifier, and produces a current wave shape as shown in Figure 3 for an impressed alternating voltage.

If, however, we want to rectify both halves of the cycle, we must supply another plate in the rectifier tube and, in one scheme, use a secondary winding of twice the number of turns shown in Figure 2. In Figure 4 we see this full-wave rectifier circuit, as it is called. Here the secondary corresponding to "A" in Figure 2 has two parts, "A" and "A^1," and the rectifier tube has two plates, "D" and "D^1". As in Figure 3, "B" is the low voltage secondary to light the filament "C" and "E" is the load. During one-half cycle point 1 of "A" will be positive with respect to center tap 2, and point 3 of "A^1" will simultaneously be negative with respect to 2. A half cycle later point 3 will be positive, and point 1 will be negative with respect to 2.

Full Wave Rectification

During the first half cycle electrons will flow from "C" to "D" because "D" is positive with respect to "C". By the same token no electrons will flow from "C" to "D^1" because the latter is negative to "C". From 2 the electrons cannot flow to 3 and "D^1" because they could not leave "D^1" to flow back to "C" once more, since "D^1" is cold and therefore not emitting electrons. The electrons are therefore constrained to flow from 2 to 4, thence up through "E" to 5 and from thence back to the filament "C" from whence they started.

A half cycle later, when "D^1" is positive with respect to the filament "C", the electrons will flow from the latter to "D^1", thence to 3, through "A^1" to 2, thence to 4, up through "E" to 5, and from there back to "C" again. It will thus be seen that regardless which plate ("D" or "D^1") is positive and hence carrying current,* the latter flows through

---

*In studying the action of vacuum tubes, it is convenient to start at the filament and trace the path of the electrons to the positive anodes or plates. This path is opposite in direction to the direction of so-called current flow, as the latter was assumed to flow from positive to negative long before electrons were discovered and found to flow actually from negative to positive. This is often very confusing to the student, which is not surprising, since most of the confusion in this world is due to error in one form or another. In the above case, electrons *actually* flow from 4 to 5. The current—a fictitious quantity—is assumed to flow from 5 to 4. In either case 5 will be positive and 4 negative.

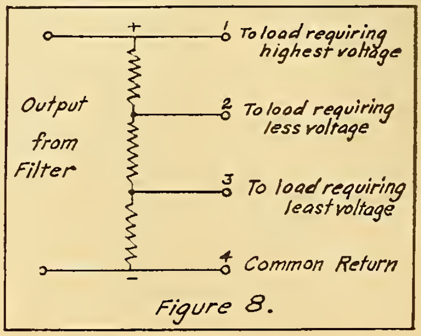

+
1 To load requiring highest voltage
Output from Filter
2 To load requiring less voltage
3 To load requiring least voltage
4 Common Return
−

Figure 8.

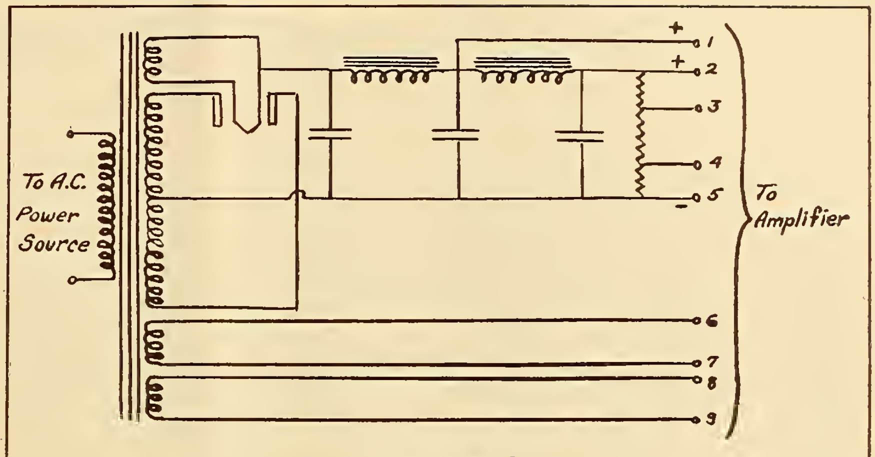


Figure 9.

"E" in the same direction, or the current through "E" is D.C., albeit pulsating in nature because of the variable character of the A.C. voltage causing it to flow. The shape of the current wave is as shown in Figure 5. It will be noted that the current pulsates at twice the frequency of the alternating voltage, and is, therefore, not suited in its present conditions for use in an amplifier.

The tube with two plates shown above corresponds to the UX-280 full-wave rectifier in such common use today. Due to the fact that the lead-in wires to both plates pass through the same glass stem of the tube, and that the voltage between the plates is twice that between either plate and the filament, a voltage higher than about 400 volts cannot be rectified because of the insulation problems in the tube itself. If higher voltages have to be rectified, it is necessary to use two half-wave rectifier tubes, and connect their filaments in parallel. In this way the effect of two plates acting upon one filament is obtained, and yet the plates are housed in separate glass envelopes, and connected to separate sockets so that there is less danger of a voltage flashover between the plates or their associated leads.

The Filter Unit

We saw in Figures 3 or 5 that the current was pulsating in nature, especially that in Figure 3 due to half-wave rectification. This means that the electrons flow in spurts, but always in the same direction. Such a pulsating flow, if it occurred in the plate circuits of the amplifier tubes, would be amplified and produce a terrific hum in the loud speakers connected thereto. The flow of this current must, therefore, be made more even in nature, and this is the function of the filter circuit. To see how this can be done, we shall refer once more to Figures 2 and 4. In either case, the D.C. voltage across the load, "E", is steady only if the current through it is steady. If the current through it, however, pulsates, the voltage across "E" will pulsate. If now we connect a condenser across "E", every time the current tends to increase across "E", and the voltage drop across it increases, some of the current will flow into the condenser instead of through "E" and thus prevent the voltage from rising to as high a value across "E". Figure 6 shows the scheme of connection. "C" is the condenser connected across the load "E", and the rectifier tube and transformer have been omitted for the sake of clarity.

As explained above, this diversion of some of the excess current into the condenser "C" tends to keep the voltage across "E" and the current through "E" from rising. When the current decreases through "E" the voltage across "E" decreases, too, and becomes lower than the potential across "C", whereupon the latter discharges through "E", thus raising the voltage across it by increasing the current through it. The variations in voltage across "E" and the current through it can, therefore, be maintained more nearly constant. The larger "C" is the steadier are the voltage across and current through "E". However, in practice, "C" would have to be extremely large to reduce the variation or ripple to the degree required by an amplifier.

Hence another device known as a choke or inductance coil is incorporated in this filter unit, and this is placed in series with the load. Finally, a condenser is usually placed after the choke coil; that is, in parallel with the load. Figure 7, A, shows this circuit, known as a filter section, and Figure 7, B, shows a two-section filter, in which the filtering effect; i.e., the smoothing out of the pulsations, is increased over that of the one-section filter.

Use of Choke Coil

In either diagram, "C", "C^1", and "C^2" are the condensers, "L^1" and "L^2" are the choke coils, and "E" is the load. The manner in which the choke coil smooths out the pulsations is as follows: The choke coil is a coil of wire—in this case wound upon an iron core. The latter increases the amount of magnetic flux set up in it by a current flowing through the coil over that which an air or other non-magnetic core would carry. As long as the current flows at a *steady* rate through the coil, the magnetic flux set up in the core is *steady* too. As long as the flux is steady, no voltage is set up in the coil of wire except the normal IR drop due to the ohmic resistance of the wire.

Let us suppose now that the current tends to decrease. The flux would tend to decrease, too, since it is set up in proportion to the current. When, however, the flux changes (decreases) a voltage is induced in the coil and this voltage is in the same direction as the current flow and therefore tends to maintain it at its original value. On the other hand, if the current tends to increase, the flux tends to increase, too, and by thus changing, induces a voltage in the coil now in a direction opposite to the current flow, and thus tends to prevent it from increasing. Thus the current sets up, through the agency of its magnetic flux, a voltage opposing any change in its magnitude.

Maintaining Current Value

The reader may at this point ask how, for instance, a current can be maintained by the choke coil at practically its initial value when the impressed voltage, which is causing it to flow, decreases. In other words, from where does the energy come? The answer is that energy has been stored in the choke coil in the form of a magnetic field. This energy initially came from the electrical source when it originally built up the current to its present value. If the potential of the source is lowered, energy is immediately extracted from the magnetic field in order to maintain the present magnitude of current. If the potential of the source increases, and thus tends to make the current increase, more energy is stored in the magnetic field, and thus prevents the current from immediately rising to its final higher value until this energy has been completely stored.

The reader has no doubt also noted how this action here is exactly the same as that producing a counter voltage in the primary of the transformer. In fact, when the secondary or secondaries of the latter are left open-circuited, it becomes nothing more than a choke coil.

We now see how the choke coil helps to prevent the current from pulsating through it and hence through the load "E", and so also maintains the voltage across "E" constant. The current will pulsate to a slight degree through the inductance, and this is prevented in a large measure from passing through the load "E" by the second condenser, C. (Figure 7.) If

(*Continued on page* 27)

Motion Picture Film in the Making

By FRANKLIN COURTNEY ELLIS

Mr. Ellis continues his engrossing story of the manufacture of motion picture film with a description of the process involved in the production of the chemically pure silver nitrate so essential to photography, the emulsion coating process, and the method of cutting the film to exact dimensional standards. The author is associated with the Eastman Kodak Company of Rochester, N. Y.—THE EDITOR.

Part II

"THE poor benighted 'indu" of whom it is reported in the familiar Limerick that "for clothes 'e makes 'is skin do" doesn't prove a very good customer for the Messrs. Hart, Schaffner & Marx. Yet his wife wears silver jewelry. If nothing else, Brother Indian is silver-conscious, even though his country has gone on the gold standard.

The Great Essential

The cinema world has better reason than the East Indian to be silver-conscious. No change of policy nor any legislative decision can devalorize silver as the one material without which there would be no motion picture industry and the absence of which would make it useless to employ thousands of persons and an enormously impressive array of machines in the manufacture of film.

The typical film manufacturing plant, with the workings of which THE MOTION PICTURE PROJECTIONIST acquainted readers in May, receives daily a shipment of silver that is large in comparison with the requirements of any other industry or even of the Mint. More than four tons a week, in the form of ingots, passes through the storage safe.

The thought of using such a large quantity of silver for manufacturing is spectacular. The actual operations of turning silver into silver nitrate for use in photographic emulsions are less spectacular, but they should be interesting to any projectionist with a desire to know something of how film is made. In silver nitrate manufacture a glimpse is obtainable of the extreme methods necessarily utilized in the photographic industry to make the delicate product meet specifications every time, everywhere.

Safeguards for Purity

Into every bar of silver bullion received in this photographic plant a hole is drilled, a record number is punched. Chips from the drillings are promptly tested by the department handling the silver, in addition to an entirely independent test by a laboratory charged with responsibility for the quality of all raw materials. Impurities are rarely found in the silver, for the supply is bought with extreme purity as its object.

Even though impurities are seldom present, the inspection continues year after year. If a trace of copper or iron were permitted, unchecked, to go into the manufacturing stream, endangering photographic effectiveness, later tests would discover and eliminate the result, but time and other materials would have been wasted in the meanwhile. Production schedules would have been interrupted. Not only silver, therefore, but every ingredient, as well as every finished product and as well as products in the process of manufacture, is tested by the typical film manufactory that we are observing. Of the thousands of employes at the plant, hundreds devote their whole time to the careful inspection of materials at every stage of evolution into finished photographic products.

Evaporating Silver Nitrate Solutions for Crystallization

Observing the first step in converting bar silver into photo-sensitive materials, we shall instinctively feel that we are witnessing wanton destruction. With our realization of the traditional worth of silver, it is difficult to avoid a shock at seeing the bars of metal dissolved in nitric acid until all is fluid and nothing solid remains.

Chemically Pure Silver Nitrate

The nitric acid, it is worthy of parenthetical note, is made right in the plant under scientific conditions leading to purity of grade. Nothing can be left to chance in the manufacture of film.

Crystallizing the Nitrate

The silver nitrate solution we have then seen made is siphoned from its porcelain bowls into troughs, whence it runs through glass tubing to an evaporating room on the floor below. There, men wearing rubber aprons and rubber gloves guide the flow into other bowls, which are set on heated tables. The heat drives off water from the solution; and when the concentrated solution cools the silver nitrate crystallizes. Silver nitrate in this form would be more than suitable for most uses—but photographic manufacture is an exacting master.

Consequently, the crystals are once again dissolved in distilled water and once more crystallized. This operation is repeated many times—until all impurities are removed. Final evaporation leaves snow-white crystals, appearing like soap flakes but more vitreous and brittle. Then come careful drying processes.

Silver nitrate is sensitive to light. It gradually loses its whiteness under the influence of the sun's rays. It was this basic chemical fact that made photography—and the motion picture art—possible. The silver bromide and other silver salts of the emulsion are very much more sensitive to light than the silver nitrate from which they are derived. Silver nitrate is therefore merely a raw material for the emulsion-makers when they carry out the next stage of making emulsions; but the care taken in making silver nitrate, so briefly sketched here, assures the emulsion department that its most important raw material is reliable.

Precautions for Cleanliness

Tall chimneys are necessary—366 feet tall in our typical plant—to carry any fumes and soot high into the upper air whence they will blow away far from the manufacturing confines. Fumes evaporated off in the process of making silver nitrate are thus disposed of. Similarly, what soot leaves the power houses after efficient burning of the daily 500 tons of coal goes into the chimneys.

Well are these precautions, for no man in this very large industry knows which particular ten or twenty feet of negative may catch the "shot" of a lifetime. Even if it were not of paramount importance to have the many millions of feet running through studio cameras and theater projectors perfect, it would be necessary to take unlimited pains to avoid flaws if only to be sure that the film should not fail the great opportunity that may come to a cameraman only once in a lifetime—perhaps a unique news scene, or a hazardous plane crash by a double, or even the record of a fleeting glance that wins the public to some sensitive star.

How the film industry has progressed in its safeguards for film cleanliness and quality and stability may be observed in the department of our typical plant where the emulsion is coated on the transparent, flexible film base. There may be veterans still active in the motion picture industry whose memory extends back far enough to give them perspective on the resulting film improvement.

Coating the Film

For something like ten years after George Eastman began the manufacture of film in 1889 the process was to form the film base, and then to coat it with the emulsion, on a long plate-glass table. It is obvious, in these days of 1,000-foot reel lengths, that 1,000-foot tables would be impractical; but the machine age of film-making has conferred much greater benefits than the additional lengths possible. The close control of the emulsion coating process resulting from continuous machine operation has been important principally in yielding more perfect film. In other words, control of the conditions, including atmospheric conditions, under which the emulsion is applied to the film base is a positive manufacturing factor in addition to its perhaps negative importance in keeping anything from going wrong.

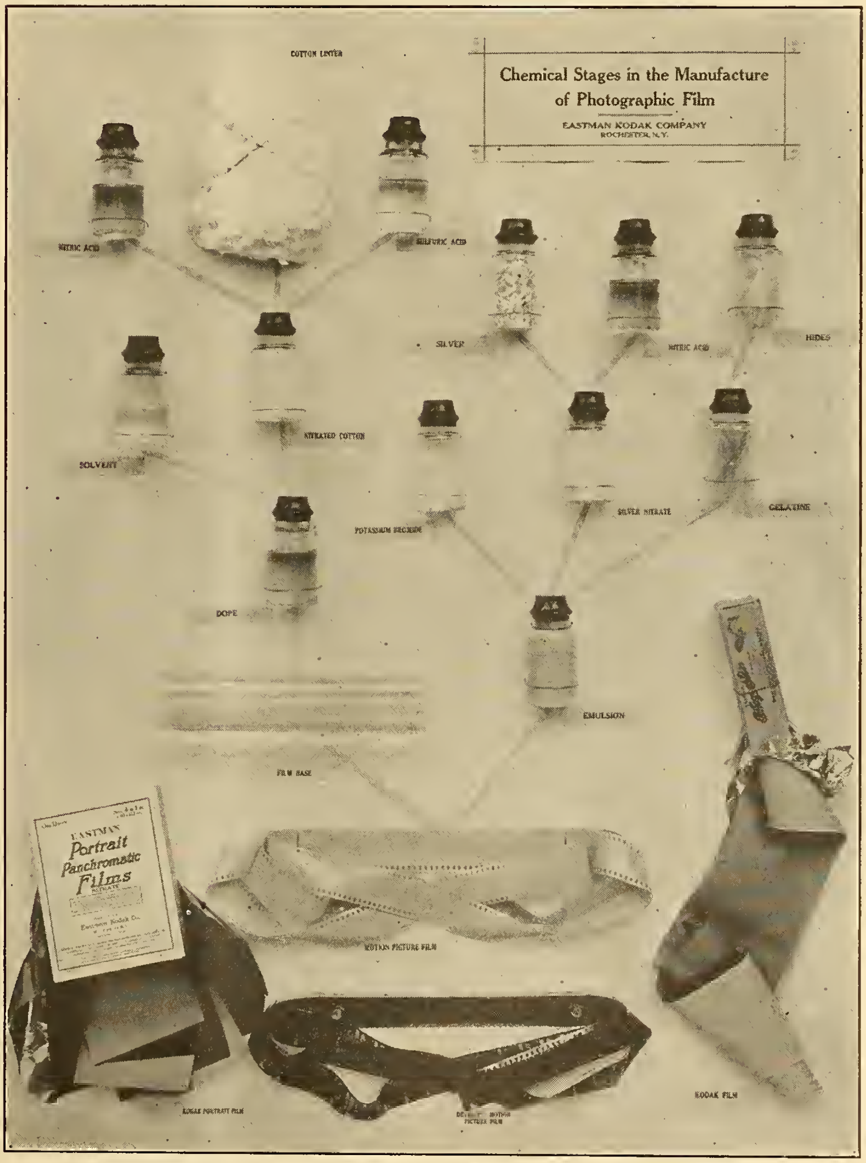
In the glass-table stage of film manufacture, whatever air happened to be in the room was good enough to dry the film regardless of dust or the weather outside—with what results in the way of perfection most of us can remember from the nickelodeons. Now, instead, an elaborate and modern system admits to the coating machines only air that has been washed, filtered, and brought to exactly the proper temperature and the right degree of moisture content. The enormous refrigeration plant of our typical film manufactory is important in doing that.

In the interest of cleanliness, even the many miles of copper air ducts in the basement below the emulsion coating machines are frequently flushed and polished, and the air comes into the system through filter bags.

Machine attendants of course wear white laundered suits and caps. These rooms, where daily miles of film are coated in the dark, are cleaner than hospitals or bakeries, to say nothing of other industries where daylight penetrates.

Motion picture film is 35 millimeters wide. That sounds simple enough, an absolute fact; and so it is. Projectionists need not concern themselves about it. But an exact film width is not heaven-sent, any more than money grows on trees. If the film were not exactly 35 millimeters wide—any foot of it—there would be no insurance against trouble in the projectors. Somebody in the typical film manufactory had to worry about the width, or projectionists would be worrying instead.

Leaving out of consideration the history of how the 35-mm. standard was set, we shall find by inquiry that cutting the film to the prescribed width once was a major problem—until it was solved. Like a thousand other details in making film, which is probably the most delicate product manufactured on a huge modern scale, the problem of exact-width slitting was solved and became just one more factor in justifying the adage that "trifles make perfection."



The Evolution of Film from Raw Material to Finished Product

How this particular problem was solved suggests a visit to another interesting department of our typical film plant of 75 major buildings and 400 acres. Slitting machines sufficiently precise could not be bought, so they had to be made.

Film-making was a mechanical art as soon as it was a chemical art. Mechanical ingenuity, plus a very large and elaborate machine shop employing extraordinarily skilled mechanical craftsmen turns out special film-making machinery for this typical film manufactory on a scale commensurate with the mighty mileage of film put forth.

Cutting Precision

Micrometrically accurate machines to slit wide bands of film off the emulsion coating machines into unvarying 35-mm. widths are only one of the mechanical products of a machine-making department that loses its identity in the necessary general perfection of the raw material for the motion picture industry. The phenomenon of a highly-developed mechanical industry buried within a chemical industry is matched by the strange realization that many of the resulting machines perform their operations in darkness.

Perforations along the edges of motion picture film are only perforations to the men who use the film; but, to the mechanical minds and hands employed in making perforating machines that will clip, clip, clip, in darkness, putting perfectly accurate perforations on thousands of film miles, the modern apparatus represents many years of patient improvement.

. . . And ever the vigilant watch for a speck of dust or a pin point of grease on the film continues.

It is of such detailed care—of which one can safely estimate 97 per cent even of the technical readers of this article never have heard—that film-making is made.

(To be continued)

Frequency Range Extended

Photophone Employs Double-Edged Track

SINCE the days when sound recording and reproduction first became an established fact, it has been recognized by engineers and scientists that the greatest barrier to fidelity lies in the limited frequency range within which it has been necessary to work.

The limiting factors have been many and varied. In the early days the entire process was more or less of a "shot in the dark" proposition. With the development of electrical recording and with it the almost simultaneous application of the principle to the reproduction of disc records so recorded, and the intense research and signal progress made in the parallel field of radio broadcasting, the frequency band has widened—slowly at first, but with accelerated speed as methodical, scientific investigation has afforded a better understanding of the nature of the problems involved.

The same general frequency limitations hold for both disc and sound film recording. As to the former, the barrier was all but swept away some six months ago when the Bell Laboratories introduced a new cellulose acetate record and applied the "hill-and-dale" method of recording. This record, in conjunction with an amplifying system capable of reproduction over a wide frequency band, and the use of a specially designed loudspeaker adapted to the reproduction of sound frequencies in the upper register, was productive of results hitherto dreamed of rather than achieved.

A similar extension of the frequency range, this time with sound-on film, has recently been accomplished by the Engineers of the Photophone Division of the RCA Victor Company. The method was to some extent explained in a paper read at the recent S.M.P.E. Spring meeting, and a sound demonstration was given which indicates without question that the new system represents a tremendous advance in the sound film field.

In the sound-on-film method of recording and reproduction, the greatest source of attenuation in the high frequencies has been the film itself, that is, for a given film speed and width of the recording light beam, there is a definite high frequency cut-off. This occurs when the width of the recording beam is equal to one wave length.

The limitations imposed by film resolution have been the occasion of considerable attenuation at a much lower figure than the theoretical cut-off. The type of emulsion is a large factor in film resolution. For a given emulsion it depends upon the manner in which the light beam enters the film, the quantity of stray light which strikes the film, and the processing method used.

Careful research on the part of company engineers has accomplished considerable progress toward the mitigation of these difficulties, with the resultant reduction of the attenuation of the high frequencies by the film.

As is generally known, the Photophone system employs the variable area method of recording, which essentially is accomplished by means of galvanometer oscillograph which, together with an optical system, is constructed in such a manner that the variations in the signal current received from the recorder amplifier are changed into variations in the movement of a narrow beam of light which is focussed on the sound track of the unexposed film.

The new method employs a galvanometer oscillograph having a large reflecting mirror. This greatly reduces the ratio of the stray to the effective light, thus making it possible to reduce the width of the recording slit and to increase the depth of focus of the objective lens in the recording optical system.

The new recorder produces a double-edged type of variable area sound track, that is, it has somewhat the appearance of two (duplicate) examples of the old type of track placed back to back. It, of course, retains the standard sound track width.

The double-edged track (incidentally, each edge is of necessity symmetrical) is produced by means of a triangular beam of light, which vibrates at right angles to the slit, thus changing the length of the illuminated portion of the slit.

A bias system of ground noise elimination is used. The action is such that when there is no signal, the triangular beam of light assumes a position resulting in a very narrow, transparent line down the center of the (positive) sound track. When a signal is impressed, the bias current is reduced, and the triangular light beam is raised until the track is of sufficient width to accommodate the signal without overshooting.

It is said that the new track may be used with existing Standard Size Photophone equipments without alterations.

For This—Much Thanks

Editor, Motion Picture Projectionist.

Being in the motion picture business for several years, I beg to introduce myself to your paper, THE MOTION PICTURE PROJECTIONIST, as I have been a constant reader of it for the past two years, and I wish to congratulate you and your associates on the excellent technical information therein.

The magazine, I find, is one which may be classed as the best for the assistant as well as the educated engineer. I have perused every magazine available in Melbourne and I am satisfied that your magazine is par excellence for the "man on the job."—*Cyril J. E. Smith, South Yarra, Victoria, Australia.*

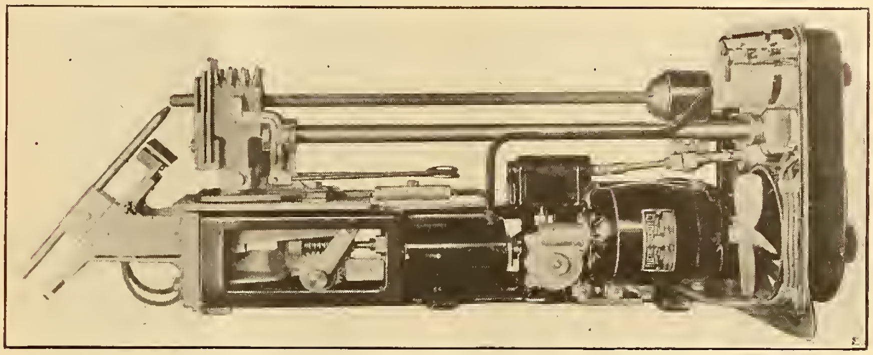
Mr. G. F. Hussey Joins the Motion Picture Machine Co.

According to a recent announcement, Mr. G. F. Hussey, formerly manager and mechanical engineer for the Precision Machine Corp., of Milwaukee, has joined the Motion Picture Machine Company also of this city, and will act in an engineering capacity. The company manufactures gears, sprockets, rollers, etc., for Simplex and Powers projectors.

A New Departure in Arc Lamp Design

By THEODORE O. HALL

It is probable that an active interest in scientific research and the systematic development of its product is characteristic of the motion picture industry more than of any line of commercial endeavor existing today. In line with this tacit tradition of action Mr. Hall describes a new arc mechanism which represents a distinct contribution to progress in the illumination field. The author is a member of the firm of Hall & Connolly, Inc.—THE EDITOR.



Electrode Feed Assembly Showing Motor

THE HC-10 superintensity projection arc lamp represents the successful culmination of many months of painstaking research and experimentation. Starting with a background of many years of successful experience in manufacture of projection arc lamps, its designers have sought unceasingly for the realization of an ideal . . . and have found it in this ultra-modern unit of projection equipment. The achievement, and it is an achievement in every sense of the word, has largely been made possible by the generous cooperation and valuable suggestions of projectionists and theatre managers throughout the country.

Thermal Control

The greatest departure from the old beaten paths of lamp design is the new method of controlling the feeding of the carbons. The characteristics of any high intensity arc are such that a slight derangement in the fixed position of the positive carbon tip, relative to the tip of the negative, causes undesirable changes of illumination. This slight variation of the carbon cannot be avoided in the old system of feed controls.

In the HC-10 lamp a very small condenser lens is placed to one side of the lamp, opposite to and facing the arc. A small flat mirror held on the same mounting with the small condenser is so tilted that the image of the positive carbon tip is projected towards the back end of the lamp onto a heat sensitive element, or thermostat.

The relative position of the thermostat condenser and the arc and of the thermostat condenser and the thermostat at the rear of the lamp is such that the magnification of the image is four times actual size, hence the movement of the image is four times the actual movement of the carbon tip as it burns away. Normally the flat mirror is so adjusted that with the carbon in its correct burning position, the image falls on a neutral point on the thermostat.

Now, if the carbon burns back of its proper position by some small amount, such as 1/32 inch, the image reaches an active point on the thermostat causing a greater flow of current through the feed motor, increasing the feeding speed until the carbon is once more in a position where the image falls on a neutral point on the thermostat and current through the feed motor is again reduced to normal. The thermostat is enclosed in a vacuum tube and does not require any attention.

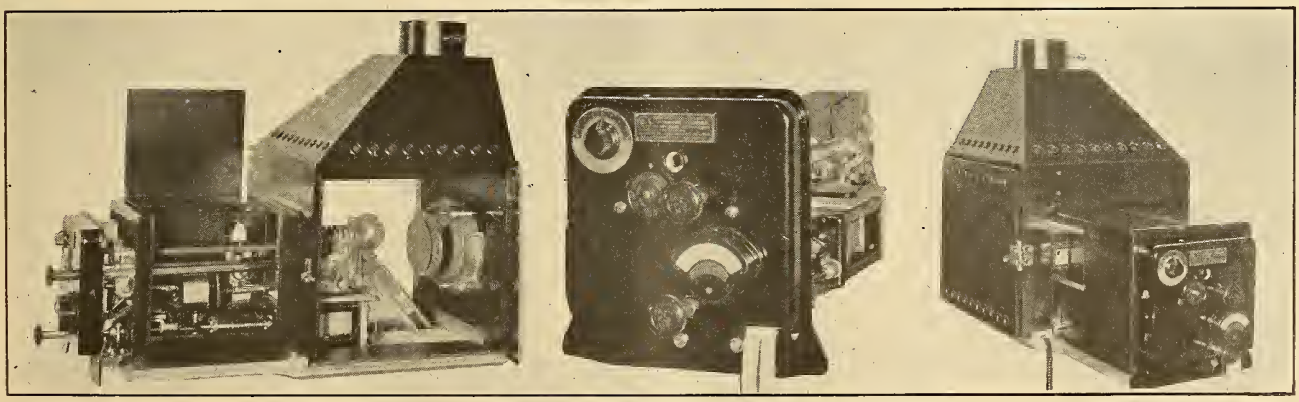
Effective air cooling has been provided in the HC-10 lamp. An air propeller type of fan is mounted on a relatively high power high speed motor that drives the lamp feeds and rotation of the positive carbon. This fan draws in large volumes of cold air from the outside of the lamphouse and distributes it to all parts of the lamp mechanism. This insures a cool and clean lamp and increases the life of the lamp parts exposed to the heat.

Stabilization of the Arc

In all high intensity lamps there are magnetic forces, or stray fields, near the arc that have a marked disturbing effect on the arc flame stream at the face of the positive crater. These disturbances give rise to sudden and undesirable surges in the ilumination on the screen. They are also the principal cause of light flickering.

Heretofore this defect has been partially overcome by letting the tip of the positive carbon extend out over the negative beyond the normal burning position. This method remedies the flickering, but is attended by a considerable loss of light. In the HC-10 lamp the stray fields are neutralized by arranging the incoming power conductors in such a way that they form a solenoid of such polarity as to oppose the disturbing fields. Hence the gently flowing steady arc flame in this type of lamp, even at overloaded conditions.

The feeding of the negative carbon may be regulated by any small



The H-C 10 Superintensity Projection Arc Lamp amount, between the limits of 40% below normal and 40% above normal speed by simply moving a pointer on a circular graduated dial conveniently located.

This lamp is equipped with a series-solenoid for striking the arc. This electro magnet acts to separate the carbons by simply sliding the negative carbon clamp along the negative head guide tracks, transmitting its power to the carbon clamp through the regular negative carbon feeding mechanism. This avoids a multiplicity of parts and promotes reliability.

All bearings that are subject to wear are fitted with either rollers, balls, or self-lubricating sleeves. All sliding bearings have low coefficients of friction. No lubrication is required except in the motor and motor worm gear casing.

Structural Details

The complete lamp mechanism is made up of six simple, easily detachable units, all attached to a suitably shaped casting frame. This lamp mechanism is complete in itself and may be operated without the lamphouse. It is inserted into the lamphouse from the rear and slides on two substantial and accurate tracks located in the bottom of the lamphouse. The back plate of the lamp unit closes the rear opening in the lamphouse.

On the HC-10 lamp there are two hollow steel tubes on which the positive carbon carriage travels, constantly rotating the carbon as it advances. These tubes are anchored at the front end in a heavy casting which also forms a steady rest for the carbon. The positive contact jaws with their levers are supported on this same casting. At the rear end the two tubes are fastened to the back plate.

This construction insures that the carbon travels true in a straight line throughout the complete trim. It also gives rigidity to the whole mechanism. The positive carriage is advanced along the tubes by means of a long feed screw located inside one of the tubes.

The negative carbon carriage also slides on tracks insuring straight line motion.

Additional Features

Other and minor features are:

Spring Chuck Positive Carbon grip, no feed rollers. It is very convenient and is guaranteed not to slip or break the carbon. This holder constitutes in itself a "carbon saver" as it grips the carbon at the very extreme end and travels right up to the positive contacts.

Positive Carbon Indicator Dial that shows at a glance the state of positive trim.

A Weston 200 Amp. Ammeter.

Hand Feed Handles conveniently located and handy to operate. No handle releases. Simply turn the handles to feed the carbons.

All Gears and Worms are concealed.

Condenser Focusing and Adjusting handles all located on the front of lamphouse.

Large, Bulky and Accurate Condenser ring with two threaded rings for retaining the condensers. Prevents condenser breakage. Condensers from 5½" diameter to 8" diameter may be used.

General construction is exceptionally heavy throughout and the life of this lamp is about double that of the earlier models.

W. E. New Wide Range

Installation at Providence

Wide Range Recording and Reproducing, the newest and most advanced development in talking picture recording and reproducing, has been formally announced by Electrical Research Products. It will be available in the near future to exhibitors and producer-licensees using the Western Electric Sound System.

Wide Range Reproducing was given its first public demonstration in a theatre before a specially invited midnight audience at Fay's Majestic, Providence, R. I., recently. The installation has since been maintained and is being used at the regular performances in the house.

Wide Range accomplishes what scientists and engineers have been striving for for a considerable time, namely, an extension of the frequency and volume ranges of sound that can be recorded and reproduced. With the Wide Range System the frequency range is extended to cover from as low as 40 to as high as 8,000 cycles.

The chief claims made for the resulting sound are a quality never hitherto reproduced, greater naturalness, intimacy, an easier intelligibility of dialogue and a more thrilling effect of great volume free from any distortion. With Wide Range it is possible to record and reproduce the extreme soft sounds of whispered conversation or the individual instruments of an orchestra together with the heaviest passages that were formerly precluded by the limitations of existing recording and reproducing systems.

Wide Range has been made possible by a refinement of recording and reproducing apparatus. The chief change in the latter lies in the introduction of a new high frequency loud speaker unit capable of reproducing even beyond the limits of audibility. Certain other modifications in the reproducing system are also involved. The demonstration at Fay's Majestic assumed additional importance not only from the enthusiasm and prestige of the invited audience but also from the sentimental interest in the fact that the Majestic was one of the first theatres to show talking pictures. It was equipped for sound on December 25, 1926.

The advantages of Wide Range reproduction evidenced at this demonstration, will become even more pronounced, it is claimed, after motion picture studios have completed the installation of equipment for Wide Range recording. The equipment for modifying a studio recording channel for Wide Range involves no major changes except the substitution of the moving coil microphone for the present condenser type microphone and the addition of simple electrical networks. High quality monitoring is also necessary.

An interesting feature of the demonstration at the Majestic is the fact that the installation was "tailor made." The equipment and installation were adapted specifically to fit the physical and acoustic characteristics of the house.

This innovation introduces the policy of recognizing a theatre's individual characteristics and will be adhered to, Electrical Research Products officials state, in all Wide Range installations.

Wide Range originated with the series of developments by engineers and scientists of the Bell System, notably the Bell Telephone Laboratories and latterly Electrical Research Products, that began with the introduction of the Western Electric Sound System. It is a natural evolution of Noiseless Recording, first announced early in 1931, which succeeded in eliminating surface and extraneous noises from talking pictures. In combination with Noiseless Recording, Wide Range represents, it is claimed by company officials, in both recording and reproduction the furthest advance that has been made to date in the development of natural, high quality sound.

Silent Class Includes 50% of European Houses

According to a recent survey conducted by the Western Electric Company, less than fifty per cent of the motion picture houses of Europe have been wired for sound. Of Germany's 5,287 cinemas only 2,500 are equipped for sound; but 1,450 of France's 3,300 theatres are equipped; only 528 of Italy's 2,500 theatres are wired.

Neumade Products Catalog

A new and comprehensive catalog of projection accessories has just been announced by the Neumade Products Corporation, of New York City. The contents list practically every item of projection equipment from splicers and rewinds to film cabinets. Copies of the new catalog may be obtained by addressing your request to the company's New York address at 440 West 42nd Street.

The S. M. P. E. Spring Meeting

Held at Washington, D. C., May 9 to 12

THE 1932 Spring Meeting of the Society of Motion Picture Engineers has passed into history. Its accomplishments will be noted in the technical developments of the next six months which must transpire before its Fall symposium. Four days of morning, afternoon and evening sessions held in the theatre of the Wardman Park Hotel, one of Washington's finest, were required to transact the Society's business.

The meeting was opened on Monday morning, May 9, with an address by Mr. John Gibbs, who represented Mr. Sol. Bloom, chairman of the Washington Bi-Centennial Celebration Committee. The response to Mr. Gibbs' address was made by Dr. Alfred N. Goldsmith, president of the S. M. P. E.

Meeting Well Attended

Despite the present deplorable economic concomitants, the meeting was well attended—a conservative estimate would place the number at one hundred and fifty, many of whom stayed over for the banquet on Thursday evening. In the interest of applied gastronomics, however, it might be suggested that the banquets of the future be scheduled for an earlier date in the program. We can't recollect for the nonce whether Bacon said it or not, but a full stomach maketh a contented mind, and it is rather questionable whether even the "groaning board" of an S.M.P.E. banquet is worth the cost of an additional night's lodging at present hotel rates.

The keynote of the meeting was, apparently, To Be or Not To Be . . . Standardized. After listening to all of the arguments, pro and con, anent the acceptance of the present RCA Photophone dimensions as the sixteen millimeter sound film standard, it became patently obvious to even a casual observer that some folks did not approve of the idea. We have a faint recollection, before succumbing to the effects of sheer weariness, of hearing that the proposal was "tabled". It will probably attain the status of a skeleton in the closet by the time the leaves begin to fall.

The complete program of the papers presented was published in last month's issue of this magazine, and since it was adhered to with the exception of a few slight modifications, it will be needless to repeat it here. A few hardy perennials showed the effect of monkey gland operations and plastic surgery, but even in these cases, the subject matter was of sufficient current interest to merit repetition.

Among the outstanding features of the meeting, was the demonstration of RCA Photophone's new "high fidelity" sound system, which accompanied a paper by Mr. G. L. Dimmick on the subject. The demonstration effectively proved that great progress in the recording and reproducing of sound-on-film has been made in the last few months. This is particularly encouraging in view of the fact that the picture industry as a whole has not been without the accusation of maintaining a rather apathetic attitude in the face of present-day economic conditions.

DR. ALFRED N. GOLDSMITH
President of S. M. P. E.

Essentially, the new system extends the frequency range of sound-on-film recording and reproduction to ten thousand cycles. Special equipment will be required to secure the full measure of reproduction, although it is said that Photophone's Standard Size equipments will give good response to nine thousand cycles with the new film.

A unique feature of the meeting was the use of the new Western Electric lapel microphone, which was described early in the program in a paper by W. G. Jones and D. T. Bell. The device is so designed that it may be attached to the speaker's clothing, permitting a greater freedom of movement than the microphones of more or less fixed position now in use.

Other Papers

Other papers of more than common interest to the projectionist included the following:

"Biplane Filament Construction—The New High Intensity Incandescent Light Source," by J. T. Mili, Westinghouse Lamp Co. The paper described the biplane staggered filament method of lamp construction, which consists of two parallel rows of coils so placed that the coils in one plane fill the spaces between the coils in the other. It was brought out that the average brightness of a biplane light source is approximately double that of a monoplane source of the same wattage.

"Short Focus Lenses for Projection with Translucent Screens," by W. R. Rayton, Bausch & Lomb Optical Co. The information presented showed that projection from behind a translucent screen appears to have advantages in small theatres designed to be operated at low rental space but that all advantage is lost unless the projection distance can be made very small for a given size of picture as compared to the usual projection distance. For this purpose lenses have been developed with a focal length as short as one inch which are satisfactory for projecting 35 mm. film. Some patents have been granted showing that all of these make use of the diverging power of a negative lense in order to cover a large field of view.

"Theatre Noise Problems," by S. K. Wolf and J. E. Tweedale, Electrical Research Products, Inc. Attention was drawn, in this paper, to the necessity of reducing the various noise sources integral with the theatre if the maximum benefits are to be gained from the great advances in the recording and reproduction of motion pictures.

Papers, Continued

"The Film Problems of Theatre Operation," by Stanley Sumner, University Theatre, Cambridge, Mass. In view of the fact that the author is himself an exhibitor, this paper possessed an added interest in that it presented the problem more or less from the exhibitor's viewpoint. Suggestions were offered as to the means whereby photography, light, sound, etc., might be less seriously impaired after film has been in use for thirty or more days. Consideration was given to remedies for the effect of bad reels and bent and damaged film cases upon such film.

"Motion Pictures in the U. S. Navy," by Lieutenant Charles E. Fraser, U. S. N. R. This paper presented briefly the part played by motion pictures in the general scheme of Naval organization, touching on its entertainment, instructional and recruiting value. An interesting point brought out in the course of the paper is that for entertainment alone the Navy owns, in duplicate, 467 features, and is procuring monthly an average of 25 features and 5 short subjects.

"Projection of Motion Pictures from Continuously Moving Film," by Fordyce Tuttle and C. D. Reid, Eastman Kodak Co. This paper, which was read by Mr. Tuttle, presented a summary of the advantages claimed for non-intermittent projectors.

(*Continued on page* 33)

The Fundamentals of Sound

By LEDWARD EVERETT

Consideration is now given to the manner in which various musical instruments function to emit sound and how the character of the sound wave which is produced serves to identify the instrument which produces it. The use of the sounding board as a means of reinforcing the sound is described and the installment concludes with a discussion of the phenomenon of the natural vibratory period.—THE EDITOR.

Part IV.

WIND instruments produce sound waves because of the air column which by various methods is caused to vibrate within them. In wind instruments of the reed type a slender flexible reed opens and closes the entrance to the air column, thus admitting little puffs of air which set it into vibration. Instruments of the reed type include the clarinet, the oboe and the saxaphone. The cornet, the trombone and the bass horn belong to another class of wind instruments which requires the vibration of the lips against a cupped opening to produce a vibrating air column.

Use is made of a variety of devices to vary the length of the air column in wind instruments in order to produce notes of various pitches. With the slide trombone, for example, the length of the air column is varied by means of a sliding tube. In the cornet, keys are used which obstruct certain sections of its tubular construction, and in the clarinet keys are utilized to open up new paths through which the air escapes.

The identifying characteristic which each of these instruments displays is dependent upon the fact that its air column vibrates as a whole to produce the fundamental tone and also in parts to produce the harmonics. This will be more clearly understood by referring to Fig. 15 which indicates how sound is produced by an organ pipe, and the manner in which its air column vibrates as a whole and also in sections to produce the characteristic quality of tone which we recognize as organ music.

In "A", the air enters through an orifice at the bottom of the pipe and a "puff" of it passes through the opening into the tube at I. This puff of air travels up the pipe as an area of compression and when it reaches the closed end of the pipe, it rebounds or is reflected back down the tube. When it reaches the opening at I, it pushes the jet of air which is entering the pipe out toward O, causing an area of compression to be sent out into the air.

When the compression area that pushed the jet of air out of the pipe has passed, a puff of air again enters the pipe causing another compression area to travel up the pipe where it is again reflected from the closed end and returns to push the air jet out through O again. This happens over and over again as long as air passes through the air inlet. The sound is produced by the intermittent puffs of air emitted at O, and the frequency of the sound is determined by the number of puffs emitted per second.

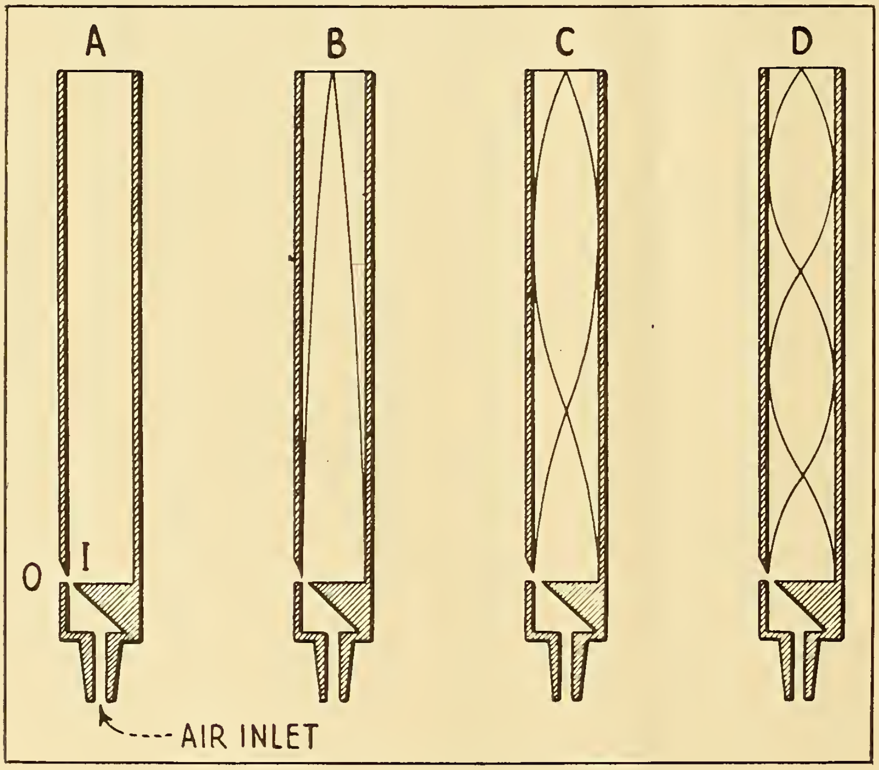


Fig. 15. *Principle of the Organ Pipe*

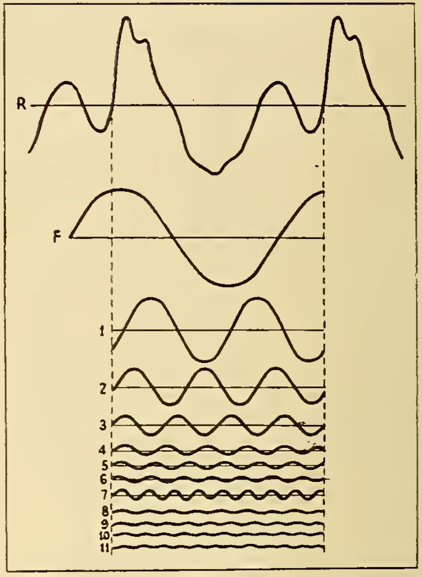


Fig. 16. *Fundamental Harmonics and Resultant Wave*

Factor Determining Frequency

It is evident that it requires a definite length of time for the areas of compression to travel up the pipe to its closed end and back again, and it is this period of time that determines the frequency of the note which is produced. It can be seen, therefore, that the longer the pipe the greater the length of time that will be required for the areas of compression to travel twice its length, and the fewer the puffs of air which will be emitted per second. This is demonstrated by the fact that an organ pipe producing a tone of 16 cycles is over 32 feet in length, while one of the smallest pipes ever made produces a note of 15,600 cycles and has an effective sound producing length of ¼ inch.

The superb richness of the organ tone is due to the fact that in addition to the fundamental tone there are eleven harmonics. Referring to Fig. 16, this is shown where "R" is the form of the sound wave, "F" is the fundamental, and wave forms 1 to 11 are the harmonics. The vertical dotted lines indicate one cycle of the wave "R" and the fundamental "F". The correct way to view this is that the wave "R" is the resultant form of the fundamental wave "F" when the eleven harmonics have acted upon it to change its shape. It is evident in this figure that the first

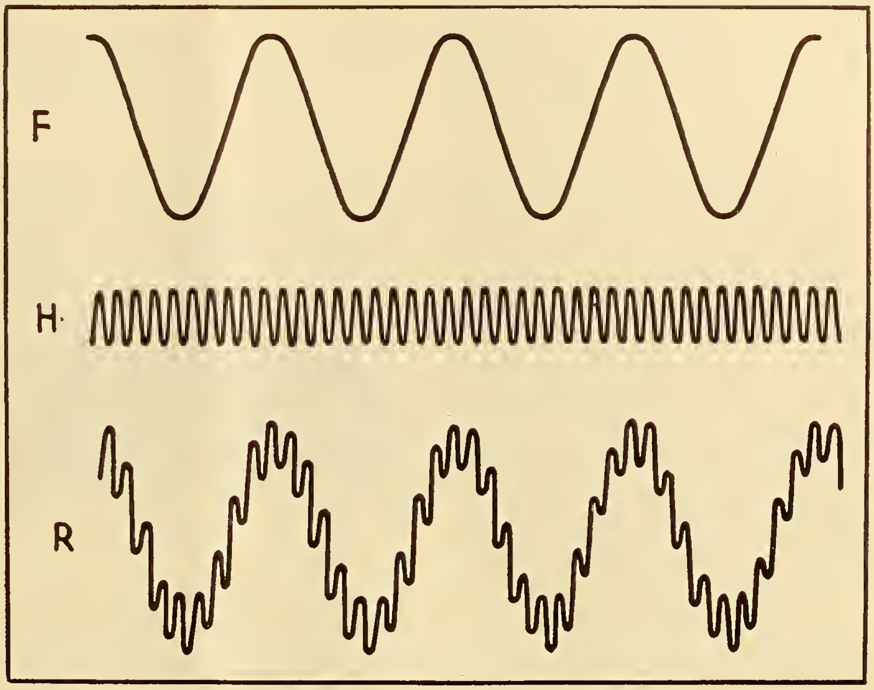


Fig. 18. *F.—Fundamental. H.—Harmonic. R.—Result*

harmonic is twice the frequency of the fundamental, the second harmonic three times the frequency of the fundamental, and so on up to the eleventh harmonic.

The set of curves shows also that in general the amplitude of the waves decreases, so that the amplitude of the eleventh harmonic is but a minute fraction of the amplitude of the first harmonic. Any wave form, no matter how complex, may be analyzed by means of certain formulae and found to consist of a combination of the fundamental and certain harmonics.

Analysis of Wave

In these days of sound recording and reproduction, it is common knowledge that the action of a sound wave may be photographed to show the wave form which it produces. Applying this to the violin as indicated in Fig. 17 produces a wave form such as shown in "R", which when analyzed shows that it is composed of the fundamental "F" and the first and second harmonics, which are designated as one and two respectively in the same figure.

From Fig. 17 it is obvious that the two valleys in the line "A"—"B" introduce a dip in the fundamental causing it to appear as shown on the same line "A" — "B" in the resultant curve "R". The effect of superimposing a harmonic on a fundamental wave may be perhaps more clearly seen by assuming that "F" in Fig. 18 is the fundamental and "H" is the harmonic.

It may be asked at this point, how it is that a body such as the diaphragm of a microphone or a loudspeaker has the property of moving in two ways at the same time, as it would necessarily have to do in order to follow the wave form say as shown in "R" Fig. 18. Let us imagine the edge of the diaphragm while at rest as a straight line. When a sound wave impinges upon it, the diaphragm is *pushed* out of its normal position by the area of compression and *pulled* in the opposite direction out of its normal by the area of rarefaction. Thus a sound wave of say twenty cycles would cause the diaphragm to move back and forth twenty times per second.

During this same interval of time let us assume that the first harmonic of forty cycles per second is also acting upon the diaphragm. Then, while the diaphragm is moving back and forth twenty times per second in response to the twenty cycle note of the fundamental, it will also move backward and forward a little at a rate twice as fast at the same time in response to the harmonic.

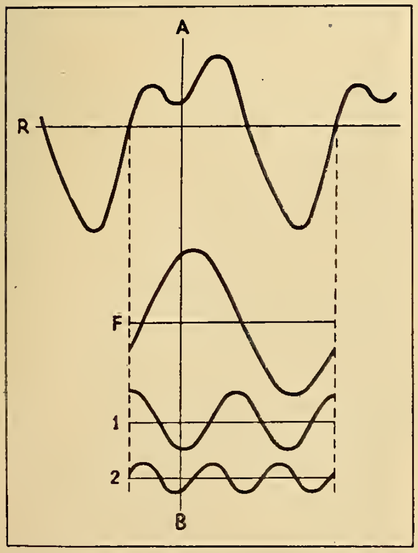


Fig. 17. *Action of Harmonics on the Fundamental*

A Simple Analogy

An analogy may be found in the idea of a man walking over a series of hills. Because of the action of walking, a person's body rises and falls a trifle as he walks, so that if we looked steadily at his head as he walked along we would see it describe a path somewhat in the form of a sine wave with an amplitude of say two inches. Now, as the man is walking over a series of hills the path which his head would follow would look considerably like the wave form "R" in Fig. 18. The center of the diaphragm can describe a path exactly corresponding to the fundamental—or the supposed hill upon which the man is walking—and at the same time respond to the harmonic as typified by the movement of his head.

The wave forms considered so far in this series of installments dealing with the subject of sound have been devoted mainly to those produced by musical instruments or tuning forks, and most of them have been simple in character. A simple sound may be defined as one that has few harmonics as, for instance, the tuning fork. Its tone is composed chiefly of the fundamental and therefore approaches the standard of what is known as a pure tone. Very few bodies produce pure tones, most of them adding harmonics to the fundamental.

The tuning fork is often mounted on a hollow box or sounding board, the effect of which is to reinforce the fundamental tone, and therefore cause the fork to emit a purer tone. The sounding board also serves another purpose in that it increases the amplitude of the sound waves and thus produces a sound of greater volume. This is accomplished by the fact that the sounding board presents a greater surface to the air, and thus when the vibrations of the tuning fork are transmitted to the sounding board and set it into vibration, it causes waves of greater amplitude to be sent out because it moves more air.

It is for this reason also that stringed instruments are provided with a hollow, resonant body, which in turn is set into movement by the vibratory motion of the strings. The piano, for example, has a large sounding board over which the strings are stretched, and which vibrates in unison with the strings. This comparatively large surface which the sounding board presents to the air produces a sound wave of considerable amplitude.

All workers with sound should be familiar with the phenomenon of the natural vibratory period or sympathetic vibrations. Every object has a natural vibratory period to which it responds more readily than to any other frequency. This phenomenon is forcibly brought to mind at times

(*Continued on page* 32)

Projecting Motion Pictures in Relief

By HERBERT E. IVES *

Practically, the solution of relief projection of motion pictures will depend upon the use of apparatus involving excessive speeds of operation, great multiplicity of taking or projecting units, projection screens containing minute ridged reflecting or refracting elements of extreme optical perfection, projection lenses of extraordinary defining power, microscopic accuracy of film positioning and photographic emulsions of speeds at present unknown. These points are covered in the concluding half of Dr. Ives' lecture which is reproduced in this issue. Publication is by courtesy of the S.M.P.E. Journal.

Part II.

A MORE practical form of screen is one of the reflection type which is exactly similar to the translucent screen described previously, except that the back surface of the rods is given a diffuse reflecting finish as, for instance, with aluminum paint. Such rods have the property of reflecting light exactly in the direction from which it is incident. A screen built of such rods, therefore, will exhibit to each eye in an audience only that picture which originates at the projector lying in its line of sight produced backward. With a battery of juxtaposed projectors in front of the screen, observers in the space between the projectors and the screen see the pictures in relief. An experimental apparatus for demonstrating relief projection of this sort is shown in Fig. 11.

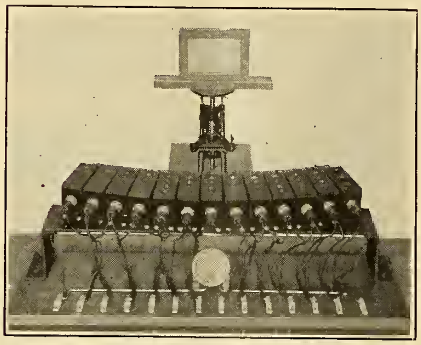


Fig. 11. *Experimental Apparatus for Projecting in Relief*

Rapid Succession of Images

Another means of avoiding the accurate registration problem and also of avoiding the necessity for a large number of projectors is to use a single projector, projecting a rapid succession of images, as from a motion picture film, but with the projector arranged to move rapidly from side to side through a sufficient distance to sweep through the whole observation angle. This scheme is obviously not very practicable because of the mechanical difficulties involved. It is possible to imagine some optical means by which the beam of light from the projector could fall upon the screen from different angles without the projector itself moving, but these again demand very large rapidly moving parts, and are of little promise.

Still another scheme, which may be described as a hybrid method, may be mentioned. Suppose that we again use a single motion picture projector, projecting in rapid succession a series of views which have been taken from different directions as, for instance, with a moving lens camera. Suppose that we place immediately behind the translucent rod screen an opaque line grating with very narrow clear spaces, and that we move this grating laterally back and forth so that each succeeding projected image falls in a series of extremely narrow bright lines upon the rear surfaces of the rod elements of the screen. (Fig. 12.) If the pictures are projected with sufficient rapidity, and if the opaque line grating oscillates in exactly the phase relations required, we shall, by persistence of vision, again have a projected motion picture in relief.

Modification of Scheme

A modification of this scheme consists in removing the opaque line grating from immediately behind the screen to the projection lantern, placing it immediately in front of the motion picture film, and imaging it accurately upon the back of the rod screen. We have here again a problem of very perfect image registration, but the problem has to be faced only once with a built-in element instead of with every picture.

There are probably other combinations of apparatus which might be devised, but the point which I wish to make is, I think, sufficiently clear—that our fundamental problem is one of providing a vast number of images, and that in order to do this we are inevitably forced either to make these images of excessively small size or to resort to a multiplicity of apparatus or to a multiplicity of projections in time. The whole problem is, philosophically speaking, a manipulation of space and time elements comparable in many ways with the problems presented in television.

Because of what has gone before, the discussion of the specific problem of projecting motion pictures in relief can be made quite brief. All that is necessary is to take one of the methods which have been outlined for still picture projection in relief, and to increase its speed to the point where the required number, say, 20, complete pictures are projected per second.

This calls for all the multiplicity of apparatus, all the accuracy of the constituent parts and other features which have been discussed, together with the additional difficulties of obtaining greater sensitiveness of the photographic materials and of performing the accurate registration operations at high speed.

The specific case of the most scientifically complete method may be gone into in some detail in order to illustrate what these requirements amount to. Let us assume that the original film is to be made by means of the large concave mirror in conjunction with the transparent ridged screen and photographic lens.

Fair Results

With this apparatus as set up for making still pictures for projection of lantern slide size, a ridged screen of approximately 200 ridges has been found by experiment to photograph down to lantern slide size with some success, provided the objects to be photographed lie very closely in the plane of the picture.

With an intense but practicable illumination, the exposure necessary with this apparatus is about one minute, due to the small photographic aperture of the mirror and the loss of light occasioned by the semi-transparent mirror used for throwing the image to one side. For the process to be applicable to motion pictures at 20 frames per second, the speed of the photographic emulsion would have to be increased by approximately a thousand times.

If the picture were photographed down to ordinary motion picture frame size, the resolving power of the film would, without going into figures, have to be far better than anything now available; and, if the number of panoramic strips were increased from 200 to 500 (¼-inch strips on a 10-foot screen), the resolving power necessary to present individual views to 100 eyes in a row at a 20-foot distance would simply be impossible of attainment because it would demand film images smaller than the wavelength of light. Much larger film than that now used would then be another special requirement.

Going over now to the projection of the picture so obtained, the problem of the exact registration of the strip images upon the projection screen is made excessively difficult by the motion of the film. Each image

---

* Bell Telephone Laboratories, New York, N. Y.

must, in turn, be so accurately positioned that no wavering of the picture occurs. This means that the film must not shift laterally by as much as one-hundredth of the width of the strip image or approximately, for the case just considered, 1/50,000 part of an inch at the projector.

When, in addition to these requirements, we remember that warping, expansion and contraction of the film material would injuriously affect the registration, it is sufficiently obvious that projection of motion pictures in relief by this method calls for a perfection of apparatus and materials quite beyond anything now in sight. The alternative methods which were noted in the last section, while avoiding the chief difficulties of registration, call, as already noted in the case of still projection, either for a multiplicity of projectors or for high speeds of projection, which in the case of motion pictures would mean some hundreds of times present projection speeds.

Conclusion

As we have reviewed the problem of projecting pictures in relief, it appears that there are two clearly differentiated methods:

(1) Involves the distribution of the images to the observers' eyes by means of apparatus individual to each observer.

(2) Calls for means of producing this distribution at the projection screen.

The practical disadvantage of the first scheme is that it involves multiplication of viewing apparatus, and some effort and inconvenience on the part of the observers. The disadvantages of the second method, as they have appeared from this analysis, are the excessive refinement of all the apparatus parts, which could be avoided only in part by having recourse to a multiplicity of projecting units or excessive speeds of projection.

In their present experimental state of development, the special screens and other devices called for by the second method of projection are too crude for projecting pictures visible to audiences of any great size, and the relief images can be produced with any satisfactory degree of definition only if the objects of interest lie close to the plane of the screen. This latter objection is entirely lacking in the first method of projection.

In fact, it may be said that in the present state of art, the only good quality stereoscopic projection which is now possible is accomplished by means of alternate projection, complementary color filters, polarizing devices, or other means operating at the eyes of the observers. The means involving distribution of the images at the screen are of great optical interest, and may be said to be completely postulated theoretically, but their practical realization on anything like a commercial basis appears remote.

It has been tacitly assumed throughout the discussion that, if the various projection schemes were worked out to perfection, the resultant relief motion pictures would possess qualities of naturalness which would add to the appeal of the motion picture. There is, however, one general consideration which must be recognized: namely, that it is not, speaking broadly, possible to project a picture in relief which will be "correct," and at the same time exhibit noteworthy relief to all members of an audience of any size, stationed at greatly different distances from the screen.

Striking stereoscopic relief is observed in real life only for relatively close objects, and the amount of relief varies with the distance of the observer from the object. If, therefore, a scene were projected in relief to natural size in the average auditorium using the "parallax panoramagram" method, in which the relief changes as it should with the distance of observers, only those members of the audience who were in the front rows would find the relief quality much of an addition to the picture.

If the first method of projection be used, in which only two pictures are taken, it is true that all members of a large audience will perceive striking relief, since the two eyes of each observer will see definitely different pictures; but it is at only one observing distance, namely, that from which the original object was photographed, that the relief will be correct. At other distances, the two pictures will correspond to points of view greater or smaller than the normal distance between the eyes, giving exaggerated or diminished relief.

Magnification and Relief

In ordinary projection, in particular motion picture projection, objects are rarely reproduced in their natural sizes; usually the screen picture is very greatly magnified. In relief projection, magnification presents a difficult problem. In the absence of relief, gigantic close-ups produce little or no impression of unnaturalness. If, however, a typical close-up were presented in relief, the appearance of the picture would inevitably be strange and unnatural to many in the audience.

For instance, if the relief picture be produced by one of the first methods, involving the projection of two images to be separated at the eyes of the observers, all the observers, as just noted, will have the same two points of view, which will correspond to eyes separated by various distances, according to the viewing position. The observers from nearby, for whom the pictured object subtends a much larger angle than normal, will be virtually seeing the object as though their eyes were separated by several feet.

In the case of the second kind of relief projection, enlarged images are, strictly speaking, ruled out. A magnified image will actually appear magnified; a face, for instance, will appear as a giant's face, larger than natural, and exhibiting the decreased stereoscopic relief that a large object does as compared with a small one of similar shape. (To put it another way, if the screen image be magnified, the separation of the eyes of the observers should be increased in the same proportion.)

Size for Close-ups

Close-ups for this kind of projection should be shown in natural size, but should be so photographed as to appear located in space in front of the screen at such a distance from the observer as to give the desired degree of intimacy. This introduces the interesting complication in this kind of projection that observers nearer than the point where the image is formed in space will be between the image and the screen, and will get no picture. Practically, it means that no image in space should be very far in front of the screen.

I do not purpose at this time to enter into a detailed discussion of these complications, but merely to draw attention to the fact that the attainment of entirely correct relief projection would carry with it an inevitable restriction in the size of the audience which would get much benefit from the added factor of relief. If the relief effects are to be entirely natural, the motion picture would have to return to a close simulation of the dimensions of the regular

(*Continued on page* 25)

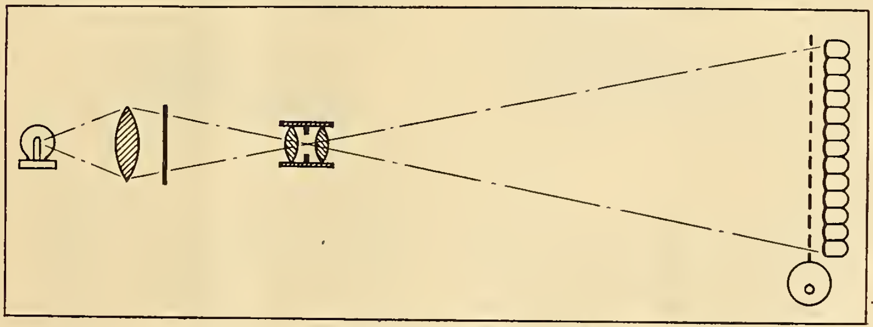
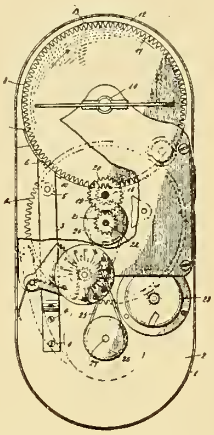


Fig. 12. A "Hybrid" Scheme Using a Large Number of Images Projected in Rapid Succession

RECENT PATENTS

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 277 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine.

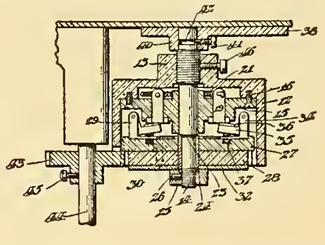
1,841,748. SOUND INDICATOR FOR FILM FOOTAGE. Isidore Marks, Boston, Mass. Filed Oct. 8, 1931. Serial No. 567,666. 1 Claim. (Cl. 116—67.)



In a motion picture camera, the combination of a supply and take-up reel, a continuous feed sprocket, an intermittent film feeding mechanism, mounted on a multiple plate structure and within said structure, a spring motor in an enclosing case with gears for driving all said mechanism, a film footage striking indicator mechanism, composed of a flexible spring, having a striking knob, and fastened at one end to one plate member and coacting at the other end with a sloping projection on a rotating member, so that periodically the knob is raised and released and strikes an adjacent metal member with an audible sound or click.

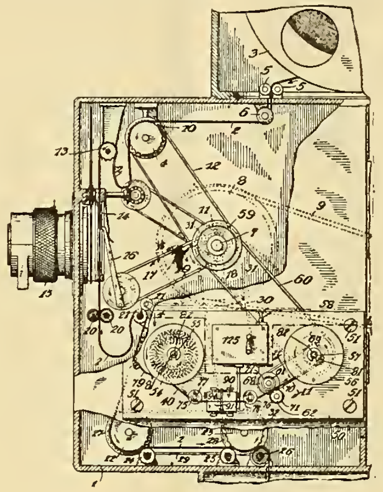
◆

1,842 644. CENTRIFUGAL SWITCH FOR MOTION PICTURE PROJECTING MACHINES. Thomas T. Allen and John Francis Adams, Philadelphia, Pa., assignors to Sentry Safety Control Corporation, Philadelphia, Pa. Filed Oct. 1, 1927. Serial No. 223,306. 5 Claims. (Cl. 200—80.)



1. A centrifugal switch including a normally stationary part, a pair of terminals spaced from one another on the stationary part, a rotatable part, contacts hinged thereon and adapted to engage the terminals, springs tending to hold the arms against swinging, and a conductor electrically connecting the arms.

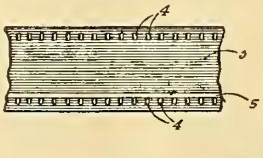
1,845,236. TALKING PICTURE APPARATUS. Henry E. Chipman, Springfield, Mass., assignor, by direct and mesne assignments, to Andrew Le Roy Chipman, New York, N. Y. Filed Oct. 8, 1928. Serial No. 311,098. 2 Claims. (Cl. 88—16.2.)



1. Combined sound and picture apparatus, including, in combination, motion picture apparatus having a drive shaft, and sound apparatus including a supporting plate, a sound recording or reproducing head, a driving shaft, a pair of reels for magnetic ribbon, one of said reels being mounted for rotation on said shaft, and means operatively connected to said driving shaft for progressing magnetic ribbon from one reel to the other through said head, all carried on said plate, said driving shaft being operatively connected to the drive shaft of the picture apparatus.

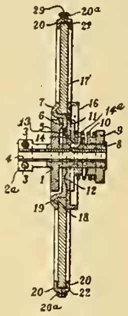
◆

1,840,459. SOUND AND PICTURE FILM AND METHOD OF MAKING SAME. Walter D. Marshall, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y., a Corporation of New York. Filed Mar. 30, 1929. Serial No. 351,191. 8 Claims. (Cl. 88—16.2.)



1. A film strip for the simultaneous reproduction of motion pictures in a single color and of sound, comprising a flexible light transmitting photographic band having a longitudinally extending area constituting a picture area and colored with a single tint and a second longitudinal area and constituting a sound record area colored with a similar faded tint.

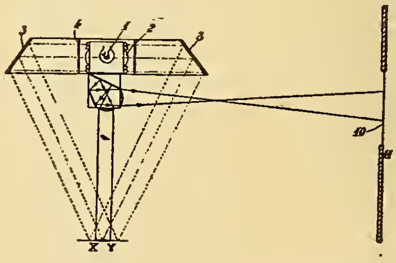
1,843,093. SHUTTER FOR MOTION PICTURE PROJECTION MACHINES. Oscar A. Ross, New York, N. Y. Filed Feb. 19, 1926. Serial No. 89,363. 9 Claims. (Cl. 88—19.3.)



1. A shutter for motion picture projectors comprising, obscuration blades formed of transparent material, a series of lineal parallelly disposed prisms formed on one face thereof, a series of similarly formed prisms formed on the opposite face of the blades, the rows of prisms being angularly disposed lineally with respect to the rows of prisms of the first named face, the faces of the prisms of both faces having a comparatively small angle of incidence with respect to the plane of travel of the blades, and a hub member for supporting the blades to form the shutter.

◆

1,842,855. EPISCOPIC PROJECTING APPARATUS. Henri Luglien Marie Joseph Bénard, Paris, France, assignor to Anciens Etablissements Barbier, Benard & Turenne, Societe Anonyme, Paris, France, a Joint-Stock Company of France. Filed June 4, 1929. Serial No. 368 299, and in France July 31, 1928. 3 Claims. (Cl. 88—24.)



1. In a device of the class described, the combination of a luminous source, an annular Fresnel condensing lens disposed about said source, a system of reflecting mirrors disposed about said Fresnel lens and adapted to throw a hollow conical beam of light to supply shadowless illumination on an operating table, an episcopic projecting device located within said hollow cone of light and including an objective located above the operating table for projecting an image of the operating table visible from outside the operating theater.

New Equipment and Appliances

GoldE Pre-Set Fader Stop

THE GoldE pre-set fader stop, a device for providing instantaneous changeover of sound without inequality of volume, is being marketed through the National Theater Supply Company by the GoldE Manufacturing Company, of Chicago.

The device consists of a friction stop with a projecting arm. The stop slides on a ring before the face of the fader and may be placed in any position around the full circle. The arm carries a rubber cushion which contacts the fader-pointer and arrests it at the pre-set positions as the pre-set fader stop has no pins and holes, ratchets, or other fix-position arresting device. Speed is another claim made for it, the company stating that a word may be taken half from one reel and half from that following without interruption and with no difference in volume.

The device is attached only by the lower face-plate screws, making unnecessary any alterations of the fader. Attachment is accomplished in about five minutes. Prevention of sudden blasting is claimed because overrunning is prevented, and diminution of volume caused by stopping short of the correct number and creeping up to it.

"Bloopers"

Eastman sound film patches, known to the industry by inelegant but expressive nickname "bloopers," because of the unpleasant sound which they have served to eliminate in sound film projection, are daily becoming more popular with the trade. Not only are they almost inaudible in their passage before the sound head light beam, but they obscure a minimum of the track and reduce splicing to a clean, quick, satisfactory job.

Here's Your Chance!

A company styled "German Narrow Gauge Film Service" (Deutscher Schmalfilm Dienst) has recently been established for the purpose of showing narrow gauge (16mm.) films in small towns and villages that are not canvassed by road-shows. Operators, stationed all over the country, will visit 12 villages in their district successively at fortnightly intervals by means of a motor cycle and will show full length programs, corresponding to 3,000 meters (10,000 ft.) of standard sized film. In such places where a school is located it is also intended to show cultural and educational films at very low admission prices.

Cathode Ray Tubes

A line of cathode ray tubes of different types and sizes, suitable for a wide range of experimental and laboratory applications, is announced by the Globe Television & Phone Corp., New York City.

The line includes two sizes of cathode ray tube with silver anode, namely, the 5-inch and the 9-inch.

This type is designed to be operated with deflecting coils on the outside of the bulb, instead of making use of deflecting plates inside the bulb. It has an auxiliary silver anode for focusing and increasing the light intensity. Connections are made through flexible leads at the base and side of bulb.

There are three sizes of cathode ray tube with deflecting plates, namely, 3-inch, 5-inch and 9-inch. This type has two sets of deflecting plates.

Tri-Ergon Television System Reported as Promising

The Tri-Ergon Musik A.G. of Berlin, which in addition to its work in sound films has been one of the most active of the German concerns experimenting in television, has, according to a recent report received from Mr. George R. Canty, perfected a new process in the television field which may have considerable influence also upon present recording processes for sound film.

The company recently applied for a patent for an apparatus which makes possible the recording and reproduction of scored motion pictures on wax discs of the usual dimensions.

No further information is available at present concerning the details of the process, but it is understood that the Tri-Ergon people will shortly be in a position to demonstrate this new process to the press.

Apropos this disc recording idea for picture and sound, some of our readers may recall a patent excerpt appearing on the Recent Patent page of our March issue. It is No. 1,841,540, Method of Recording Electrical Impulses for Producing Pictures and Sound, and was granted to Mr. Harry T. Leeming of Jersey City, filing date, May 31, 1928. It is conjectural how closely the Tri-Ergon process may approximate the Leeming idea.

Sun-Arc Carbons

Mr. L. A. Wilczek, treasurer of the Carbon Products Corporation, of New York, submits some interesting data regarding the company's products, Sun-Arc carbons and the Casco carbon saver.

According to Mr. Wilczek's statement, the carbons, which, by the way, are manufactured in France, afford a longer burning time, give off less gas, leave less ashes and deliver higher illumination. The carbons are provided with a center hole, permitting the insertion of the carbon saver, which is essentially an extension which allows the burning of hi-low and hi-intensity carbons to two inches and less. No inconvenience is occasioned in mounting the carbons in the carbon saver, due to the fact that the hole is already provided for the purpose.

It is said that this arrangement furnishes 38 per cent more of useful carbon. The hi-intensity carbons are furnished in 22-inch lengths.

National Slide Co. Formed

The announcement has recently been made of the formation of a new organization known as the National Slide Company. The office of the new company is located in New York City. The firm specializes in all types of slides for use in connection with special effects, organ solos, etc.

An interesting and attractive product now ready for dealer distribution is a new typewriter slide, which is to be marketed under the trade name Rapid-Type Slide. This slide is intended for special announcement work in the theatre. It is made in such a manner that the blank may be inserted in an ordinary typewriter, typed and instantly mounted for projection to the screen.

Projectionist's Tool Kit

A new and unique tool kit, especially designed to meet the needs of the projectionist, has been announced by the Utility Sales Company of New York City. It is said that more than one hundred projectionists were consulted during its preparation for the market.

The kit is housed in a black metal box. This box contains two metal plates upon which sixteen tools are mounted, every tool in an individual pocket. The plates are so constructed that they may be mounted on the projection room wall. Each tool in the outfit is essential to the projectionist in his daily work.

"100% value for any projectionist"

—so says H. J. Schmieder, of Easton, Pa., after examining Nadell's new book, Projecting Sound Pictures. But that's not all. Here are some other comments we have received:

"I consider it the best book of its kind yet published."—E. B. Olson, Supervisor of Projection, Warner Bros. Theatres.

"There is nothing in the theatre that is better value for money than this book."—The Bioscope (British).

"Will give the reader a clear understanding of the intricacies of operating sound equipment."—Film Daily.

"Mr. Nadell proceeds from theory to practice with considerable ease, and combines both elements in an understandable whole."—International Projectionist.

YOU too will find this the clear, simple, explanation of sound equipment, its operation and repair for which you have been looking. Gives the fundamental principles on which all makes of equipment are based. Explains their use so that you can recognize the nature of any sound trouble, trace it to its cause, diagnose its importance, take the right steps to correct it. Show when and how repairs can be made in a hurry—when replacement of parts is necessary. A real key to better sound projection.

PROJECTING SOUND PICTURES

By AARON NADELL

Publix Theatres Corporation; Formerly of Electrical Research Products, Inc., 265 pages, 6 x 9, 100 illustrations, $2.50

Everything in this book is practical and explained in understandable language. Instead of describing all makes of sound equipment in detail, the author clearly outlines the fundamentals of mechanisms and circuits found in all sound apparatus, and which, when understood, makes easy the location and cure of all sound troubles.

Covers theory and mechanical requirements ot sound-on-film and sound-on-disc

—projectors, amplifiers, rectifiers, loud speakers, motors, generators — their principles, operation, maintenance

—photo-electric cells, vacuum tubes and circuits

—acoustics

—care of sound equipment and precautions to prevent trouble

—tracing trouble.

See it 10 days FREE—Send Coupon

McGraw-Hill Book Co., Inc.,
330 West 42nd Street, New York City

Send me Nadell-Projecting Sound Pictures, postpaid for ten days' free examination. I will send $2.50 or return the book within ten days of receipt.

Name ....

Address ....

City and State..........

Position ....

Company ....

MP-5-32

Telephoto Making Caesium P.E. Cell

THE Telephoto & Television Corp., of New York City, is now manufacturing a complete line of photoelectric cells of the Caesium Argon type for the various sound heads now in common use.

Caesium, one of the components of the Telephoto cell, has long been known as a metallic chemical element whose electrical conductivity varies with its exposure to light, but it is only since the development of the photoelectric cell that this property has been put to practical use.

The Telephoto photoelectric cell is an electron tube similar to the ordinary vacuum tube and contains two elements, an anode and a cathode, the latter of which is sensitized with Caesium. When light strikes the cathode, electrons are emitted from it and flow to the anode. In the Caesium Argon photoelectric cell, argon gas is used in place of a vacuum as the best means of facilitating this flow. Since the emission of electrons depends on the amount of light striking the cathode, any variation of light will cause a corresponding change in the current output of the anode.

Voltage Rating

Telephoto photoelectric cells are designed to operate at an anode voltage of 90 volts and at this voltage give an output suitable for use in the particular apparatus for which the cells were designed. Although the cell is not injured by ionization or glow from short periods where a suitable series resistance is in the circuit, no higher anode potential should be used than 90 volts, as the positive ion bombardment of the sensitive surface by higher potentials will eventually destroy the sensitivity of the cell and greatly shorten its life.

Control of electric current by light, made possible in this way by the photoelectric cell, has opened new fields in engineering, industry and science. The varied applications in which Telephoto photoelectric tubes may be used include: Talking Pictures, Television, Colormetry, Counting, Grading, Industrial Safety Devices, Daylight Recording, Cloth Examination, Photo-Telegraphy, Chemical Analyses, Galvanometric Measurements (in conjunction with mirror galvanometer), Beam Transmission of Speech and Music, Physiotherapy (Ultra-violet dosage meters), Metallurgy, Light Control, Inspection of manufactured products, Door Openers, Elevator Controls, Self-Levelers and Spectroscopy.

Chief among these is the production of talking pictures in the projection of which Telephoto tubes are used to transmute light into sound. The talking movie film carries, besides the picture, a series of short horizontal lines known as the sound track, the distance apart of these lines corresponding to the form of the sound wave being reproduced. These marks interrupt the rays from a light as the latter pass through the film to a photo-tube and thus the current which energizes the coils in the loudspeaker is made to flow in the form of the photographed sound wave which the marks represent.

While the photo-tube does not differ greatly in principle from the ordinary vacuum tube, much more exacting methods are called for in its manufacture.

Output Requirements

For talking picture operation it is important that the tube should have a high signal output with an absence of "rush" noise or similar disturbance. Experience in the development of the photoelectric cell from its earliest stages, coupled with rigid supervision of manufacture, results in the production by the Telephoto and Television Corp. of a tube that meets every requirement in an exceptionally high degree. Each cell is made under conditions closely approximating those in the best research laboratories and final tests, following an aging process, are performed under standards set by the leading engineering societies.

Telephoto Caesium Argon cells are also playing an important part in experimental laboratories devoted to television research. Their extreme sensitivity and consequent high speed response are essential factors in this field.

In addition to the Caesium Argon Telephoto cell, the above company has developed a Crater tube in both the hot and cold cathode types . . . and has been supplying several large concerns with these tubes for their experimental work. These Crater tubes have not yet been standardized, as each company has its peculiar requirements as to the size of crater opening and operating voltages.

Society Note

Among the more active members of the younger set attending the recent S.M.P.E. Convention was Mr. P. A. McGuire, of the International Projector Corporation. Known throughout the length and breadth of the industry as an earnest and enthusiastic champion of the cause of projection and projectionists, a cause which he was ever ready to bring to attention during the four more or less trying days of the Spring Meeting, Mr. McGuire demonstrated at the banquet on Thursday evening that for vivacity, wit and good-natured fun there are few persons who may be called his equal.

All in Readiness

Columbus, May 28.—Everything is in readiness for the Thirty-first Biennial Convention of the International Alliance of Theatrical Stage Employes and Motion Picture Machine Operators, which opens here with pre-convention district meetings on June 2. The convention proper opens Monday, June 6, and will last for the next six days, closing with the annual election.

William C. Elliott, of Cincinnati, president of the organization; Fred J. Dempsey, Boston, general secretary-treasurer, and John P. Nick, St. Louis, first vice-president, will arrive in Columbus on May 30, and open a headquarters at the Neil House which will be convention headquarters.

Business sessions begin on Monday, June 6, at Memorial Hall, where there will be taken up vital questions of union operation and legislation. Six of Columbus' largest hotels have taken heavy advanced registration of stage hands, moving picture operators and movie camera men, and the prospects are for an attendance of one thousand delegates, and two or three times this number of relatives, friends and union members.

The local committee which is headed by Charles E. Pratt, Majestic Theater, and Larry Buck, Loew's Broad Theater, has arranged a program of social events which include a dancing party at a suburban ballroom, an afternoon and evening at one of the largest Ohio amusement parks, and other events for the visitors.

Stage hands, operators and camera men from every state in the Union, almost every Canadian province and from Panama, are expected. Governor George White, of Ohio, mentioned as a possibility for the national nomination for vice-president, will greet the delegates at the opening session of the convention.

Recent Accessions
S.M.P.E. Museum, Los Angeles

The make-up box, once the property of Lon Chaney, that brought chills and shudders to thousands of picture-goers, has been placed on exhibition at the Society of Motion Picture Engineers Museum in the Los Angeles County Museum in Los Angeles, according to E. Theisen, chairman.

Projecting Motion Pictures in Relief

(*Continued from page* 21)

stage, abandoning one of its unique advances over the stage, namely, the "close-up." Doubtless, were relief projection to become feasible and commonplace, a special art would be developed, which would strike some workable compromise between the appealing qualities of relief and the unnatural distortions which great magnification would introduce.

DISCUSSION

MR. KELLOGG: When the two views of the Capitol at Washington were shown, I wondered how far to the side one could go before the actual difference in the size of the pictures makes it practically impossible to merge them.

MR. IVES: I do not know. Stereoscopic relief can be obtained with one of the two images in very poor shape. I imagine one could tolerate a lot of distortion and yet get the effect.

MR. GAGE: These parallax panoramagrams, particularly those that are colored, are very pleasing. However, I wonder, although they may be interesting as novelties, whether they would be desirable as a regular thing in the theater. This is a question that ought to be considered here.

PAST-PRESIDENT CRABTREE: I believe that the mind can imagine a lot of things. If the necessary willingness to believe is created in the observers, they will undoubtedly imagine a certain amount of relief, both in the sound and in the picture.

Replacement parts for

Powers-Simplex Projectors

15 years' experience in building precision machinery and motion picture parts enables us to guarantee your complete satisfaction on gears, sprockets, film rollers, studs, shafts, screws, springs, etc. Any part sent for inspection at our expense. Write for our new catalogue listing over 1,500 different parts. Ask about our special discount to reputable firms. Quality—price—service. You can't beat it, when it's from

MOTION PICTURE MACHINE CO.
C. F. HUSSEY, Pres.
3110 W. Lisbon Avenue Milwaukee, Wis.

Sell to Jobbing and Supply Dealer only.

SUN-ARC CARBONS

for

PERFECT PROJECTION

"Best by Test"

BIG SAVINGS—COMPLETE SATISFACTION

Casco Carbon Saver for Hi-Low and Hi-Intensity carbons, FREE OF CHARGE. Permits the burning of carbons down to 2" and less.

Carbons furnished *ready for use.* No inconvenience whatsoever for the operator.

Samples on request. Address

CARBON PRODUCTS, INC.
324 West 42nd Street New York City

Mr. Kurlander: In view of the many difficulties in getting true stereoscopic effects, is there not a simpler method of creating a pseudo effect that would be better than the present flat effect?

Mr. Ives: A great deal can be done by lighting, and by poor depth of focus. And where the nature of the subject will permit, the relative motion of the camera and object provides a beautiful relief. But this is a subject to which I have not given much attention. I was talking about binocular or stereoscopic relief.

Mr. Victor: May I offer, as my personal belief, that we will eventually find the solution to stereoscopic relief in colors? Every artist knows the value of color perspective, and I think that some day we shall have a color projection system that will give us very nearly the effect of stereoscopic pictures.

Mr. Ives: There is a beautiful painting in the Gardiner Museum, in Boston, which I would cordially recommend to everyone interested in this line of speculation. It is a picture by Sargent—a group of dancers with musicians in the background. It is lighted with spotlights, in a rather long room, and as one enters through a door at the back, he obtains a remarkable illusion of relief.

Mr. Kellogg: Concerning the true stereoscopic effect, when two pictures are merged, there is only one plane in registration. Everything else is out of registration, and in so far as the images of the two objects eyes fuse in the consciousness, there must be a blur. Now, a number of efforts have been made to produce three dimensional pictures, I believe, by printing two photographs or otherwise combining them into a single picture which both eyes see, and in which everything in one plane is sharp and everything in any other plane is double. I should like to know whether, as long as one is willing to center his attention on that one plane, it provides any better sense of depth than can be gotten from any ordinary sharp picture.

Mr. Ives: My comment on that would simply be that it does not conform to the second of my series of points—that appropriate images are not distributed to the appropriate eyes.

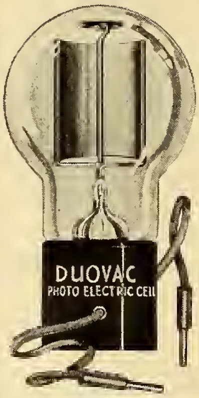
Mr. Gregory: Has cylindrically lenticulated film been used for the taking of parallax panoramagrams?

Mr. Ives: Yes, it has. It is more efficient in utilizing the light.

Mr. Maxfield: There is an effect I have noticed quite frequently on entering a motion picture theater; someone coming out swings the door open, and I see a close-up on the screen standing out in beautiful third dimension. On measuring approximately the distance from the place where I had noticed that effect, to the screen, it looked as though the close-ups had been taken with approximately a four-inch lens. I was viewing the picture from my position, at the same angle subtended by the lens when the scene was photographed, assuming that a long focus lens had been used on the close-up. I should like to ask Mr. Ives if he has any information regarding the relative importance of really correct perspective *versus* binocular, where one views the picture from a relatively long distance.

Mr. Ives: I do not know anything about viewing from a long distance. It is well known in ordinary photography that for a picture to present correct perspective it should be viewed from the distance which held between the lens and the plate. And by looking at such a picture at that distance with one eye, I have heard that one gets a sensation of relief. What happens is, that he does not miss the other eye so much. Personally I do not get a sensation of relief by looking at a picture with one eye at that distance. But people tell me they do.

Mr. Maxfield: I do.



OPERATORS in COLUMBUS, ATTENTION!

PHOTO-ELECTRIC CELLS

(CAESIUM ARGON TYPE)

Write for descriptive folder illustrating the new 242. Power Amp. 264A, designed to replace the 239A, and the 205D. Also other tubes for all sound systems.

Guaranteed longer life, unaffected by heat through continuous usage and offers a new degree of tone fidelity—the result of Duovac painstaking research. Guaranteed, non-microphonic.

Complete tube equipment now available for the following sound systems: WESTERN ELECTRIC, R. C. A. PHOTOPHONE, De FOREST PHONOFILM, PACENT, and every other standard make.

• DUOVAC •

RADIO TUBE CORPORATION
360 FURMAN STREET
BROOKLYN, N. Y.

Guaranteed!* BETTER SOUND—*Lesser Cost

TALKING PICTURES

By Bernard Brown

A detailed discussion of the principles of construction and operation of sound film apparatus including a complete history of its development. Of great importance is the full account of R.C.A. power system and the Western Electric speaker unit. Specially valuable for operators, technicians, and also the general reader. Many illustrations and charts. Second Edition. **$3.00.**

TELEVISION—TODAY and TOMORROW

By Sydney A. Moseley and H. J. Barton-Chapple. $2.50.

Write for descriptive lists

ISAAC PITMAN & SONS, 2 West 45th Street, New York

Give This to Your Friend—Have Him Fill It in and Mail to us at Once

The Motion Picture Projectionist
7 West 44th Street, New York City

Gentlemen:

Enclosed please find $2.00 for which enter my subscription for one year (12 issues) starting with..............................issue. (Two years, $3.00.) Add 50 cents for Canadian postage; $1.00 for foreign.

Name ....

Street ....State ....

City ....Local No. ....

Power Pack Theory

(*Continued from page* 11)

the filtering action of this first section is not sufficient, a second filter section may be used. This is usually sufficient for most purposes, although for extremely smooth current flow a three section filter is sometimes employed. Thus, by the use of choke coils and condensers, a steady direct current is obtained at the desired high voltage from the alternating current source.

The Voltage Divider

The voltage divider consists of a resistor suitably tapped at certain portions of its value to give the desired voltages required for the various components of the amplifier. In Figure 8 such a device is shown in schematic form. The full D.C. voltage is obtained between points 1 and 4, as these two terminals are connected directly to the output of the filter. To these points would be connected those loads requiring the highest voltage.

The entire voltage divider resistance is connected between these points and as current I flows through this resistor R, an IR voltage drop is set up that is equal to the total voltage across points 1 and 4. Across any portion of the resistor, the voltage drop is equal to the current through it times the value of that portion of the resistor. This is, of course, less than the value of the total resistance, so that even if the current were the same throughout the entire resistor, the voltage drop across the portion of the resistor would be less than that across the entire unit. In this way any desired lesser values of voltage may be obtained from the total voltage across points 1 and 4.

Due to the fact that the current flow through the various parts of the resistor is not the same because some current is diverted from each tap to the load connected thereto, it is not so simple a matter to calculate the value of the portions of the resistor between the various taps. A sample calculation will, therefore, be made here to show how this is done. Let the various voltages and currents desired be as follows:

Tap	Volts	Current
1	300	64 M.A.
2	135	10 M.A.
3	45	Negligible (to supply screen grid)

The above voltages are assumed between the given tap and tap 4. In addition, we must assume some value of current that flows through the resistance in addition to those drawn by the amplifier. The former is known as the "bleeder" current, and serves two useful purposes.

The first is that by drawing current from the power transformer and rectifier tube or tubes, irrespective of whether or not the amplifier is connected to the power pack, an abnormally high voltage across any of the terminals is prevented. This is

TRADE MARK
Neumade
SUN-LITE
FLOOD LAMP

Adjustable to any angle

JUST OUT

$7.50

Floodlight for every theatrical and advertising purpose; crystal finish; takes 250 or 400 watt concentrated filament bulb. Will also accommodate standard lamp.

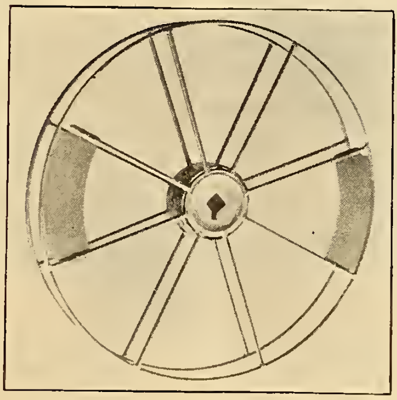
Water-proof rubber cord and plug.

NEUMADE PRODUCTS CORP.
Gentlemen:
Please send me your catalog of Neumade Products.
Name ....
City ....
State ....

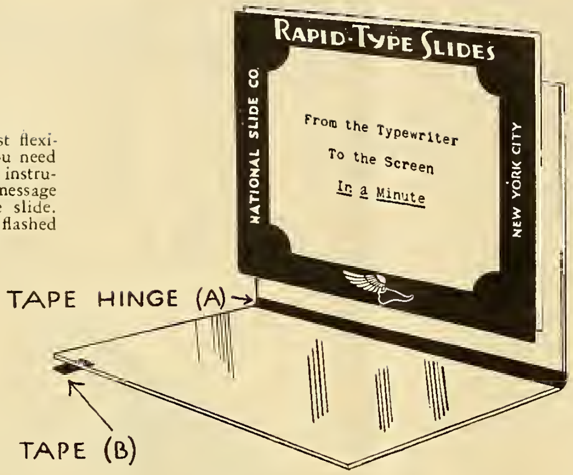
Our long list of projection room products are backed by manufacturing facilities of the highest order and carry a guarantee of efficient and long-time use.

TRADE MARK
Neumade Products Corp.
MANUFACTURERS
440-442 W. 42nd St., New York

Discounts in Quantities



16 MM
FILM REELS
FOR PROFESSIONAL AND
HOME MOVIES
—ALSO—
35 MM SOUND REELS
10″—11″—14″—15″
UNIVERSAL
ELECTRIC WELDING CO.
9-16 Thirty-Seventh Avenue
LONG ISLAND CITY, N. Y.



A RAPID-TYPE SLIDE is the most flexible screen vehicle available. All you need is a typewriter. Any dull pointed instrument will do equally well. Your message takes a minute to transcribe to the slide. In another moment its message is flashed to the patrons in your audience.

Talk to Your Audience

Use daily for announcing:
baseball results
contests
requests for silence
songs
publicity for community drives, coming pictures, etc.

In another few weeks the two political conventions will select their candidates. The whole country is waiting impatiently for the selections. Millions of people will be sitting in theatres at the moment the candidate is chosen. FLASH his name on the screen with a RAPID-TYPE SLIDE. You will beat the newspapers by hours and win the approbation of your patrons.

We live in a hectic world. Great news events move upon us minute by minute. Now it is the Lindbergh kidnapping. Next minute it is a great earthquake, a revolution, a big man dies, a sudden change in government, a sensational murder, the local ball team wins—or loses—this is the stuff that grips your patrons. Snap up your show with up-to-the-minute news. Give it to them red-hot as it flashes into your town.

A RAPID-TYPE SLIDE can be used in a hundred different ways.

Snap Up Your Show

With

RAPID-TYPE SLIDES
manufactured by
NATIONAL SLIDE CO.
NEW YORK CITY

From the Typewriter *To the Screen*

Ask your nearest theatre supply dealer or write direct to

NATIONAL SLIDE CO., 7 WEST 44TH ST., NEW YORK CITY

due to the fact that the ordinary rectifier tube has a rather high internal resistance, so that from the generated A.C. voltage rectified by it must be subtracted the IR drop in it as well as that in the filter chokes in order to get the voltage across terminals 1 and 4. If no current were to be drawn, the voltage across 1 and 4 would be that rectified by the tube, and this is considerably higher than the normal voltage. This would stress not only the filter condenser unduly, but any by-pass condensers connected across the various taps. By drawing a "bleeder" current, however, the voltage is kept down to a safe value even if the amplifier is not connected to the terminals.

The second purpose is to maintain the voltage between the various taps practically constant and independent of the variations in current drawn by different tubes placed in the amplifier fed by the power pack. The explanation is similar to that given above; namely, if the current we have assumed flowing out of tap 2 is 11 milliamperes instead of 10 milliamperes, and the bleeder current is 10 milliamperes, for instance, then the change in voltage between tap 2 and 4 will be $1 \div (10 + 10)$ or 5 per cent instead of $1 \div 10$ or 10 per cent.

A Problem Solved

We can now proceed with our problem. The 64 milliamperes flowing out of tap 1 (and returning through tap 4) does not flow through the bleeder resistor and need not be considered any further. The 10 milliamperes flowing out of tap 2 must come through that portion of the bleeder resistor between taps 1 and 2. In addition, there flows in this portion the 10 milliamperes of bleeder current, or a total of 20 milliamperes. Since the voltage between taps 1 and 4 is 300 volts, and between 2 and 4 is 135 volts, the voltage between 1 and 2 is $300 - 135 = 165$ volts. Therefore, the resistance between 1 and 2, call it R_{1-2} is $\frac{165}{.020} = 8250$ ohms, by the application of Ohm's Law.

Similarly, the current in the resistance between 2 and 3 (call it R_{2-3}), is 10 milliamperes plus a negligible amount out of tap 3, or 10 milliamperes, total.

$$\text{Therefore, } R_{2-3} = \frac{135-45}{.010} = \frac{90}{.01} = 9000 \text{ ohms.}$$

Finally, for the resistance between 3 and 4, call it R_{3-4}, we have

$$R_{3-4} = \frac{45}{.010} = 4500 \text{ ohms.}$$

This should give the reader some idea of the method of calculating the values of the various parts of a voltage divider resistor.

We have thus completed our study of the power pack. Due to lack of space, this analysis has been rather sketchy, but nevertheless it is hoped that the fundamental principles have been grasped by the reader, and that he is now prepared to study Figure 9, which shows the component parts connected up to form a complete power pack.

As can be seen, full wave rectification and a two section filter is employed. Terminal one may require explanation. This comes from the junction of the two filter chokes. The reason for tap one is that most amplifiers employ push-pull amplification, in the last, or power stage, and this does not require current as completely filtered as the previous stages. Therefore it is not necessary to draw the current for the push-pull stage through both filter chokes but only through the first, as shown above. The second choke can thus be made smaller, as it does not have to carry the large direct current drawn by the power tube.

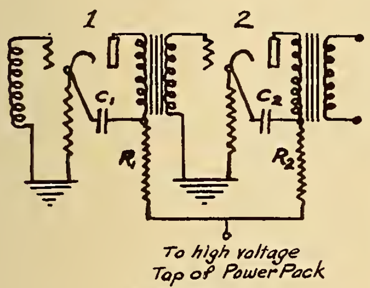


Figure 10.

The other tubes require more perfectly filtered current, hence they draw this through both chokes and out of tap 2. Tap 3 supplies current at a lower voltage, while tap 4 supplies it at the lowest voltage of all. Tap 5 is the common return for all the current, and is usually grounded. Taps 6 and 7 supply alternating current at the proper low voltage for the heaters or filaments of, say, the amplifier tubes, and taps 8 and 9 the filaments for the power tubes. The reason why taps 6 and 7 are not used for the latter tubes is that the filaments of the latter must be made positive to ground by the voltage across the bias resistor connected between them and ground. When the grids of these tubes are then grounded, they are made negative to the filaments or are biased with respect to the filaments so as not to draw current and cause distortion.

Sometimes the filter chokes are placed in the negative side of the filter unit. This has the advantage that the windings are not at as high a D.C. potential to their cores (which are usually grounded), as they are in the above case. In such a case the D.C. drop in the winding (due to its ohmic resistance) can be used as a grid bias and this IR drop puts the negative end of the choke winding to which the power tube grids are connected *below* ground in potential. The filaments of the power tubes can, therefore, be at ground potential, so that taps 6 and 7 can be used to supply filament current for the power tubes, and thus the secondary winding connected to taps 8 and 9 can be omitted. If the voltage drop in the choke coil is greater than that required for grid bias, a potentiometer may be connected in parallel with the choke, and the proper voltage tapped off for grid bias. This potentiometer functions in a manner exactly similar to that of the bleeder resistor shown in Figure 9.

The vacuum tubes of the amplifier

THEATRE EQUIPMENT
NEW AND USED

Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.

Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.

We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.

Everything for the Theatre—Write for Catalog K.

MOVIE SUPPLY CO., 844 So. Wabash, Chicago.

GARDINER

Welcomes
The Motion Picture Operators
of the United States and Canada
to Columbus

THE L. J. GARDINER COMPANY is an independent organization and the interest of every independent exhibitor is best served and protected by favoring us with your business. We solicit the sincere attention of all motion picture operators to our product.

THE NEW GARDINER PERFORATED GOLD FIBER (*Seamless*) SOUND SCREEN

has solved the problems of the exhibitor in giving a clearer picture and better sound effect than that obtained with other screens. The GARDINER (*Seamless*) SCREEN produces a brilliant picture, rich in color tone, fine definition and deep perspective and yet the sound filters through as clearly as the spoken production.

With a GARDINER (*Seamless*) SCREEN a high intensity or other high-priced lamp is not required to overcome projection problems, but the ordinary type reflector arc lamp will give all the illumination necessary.

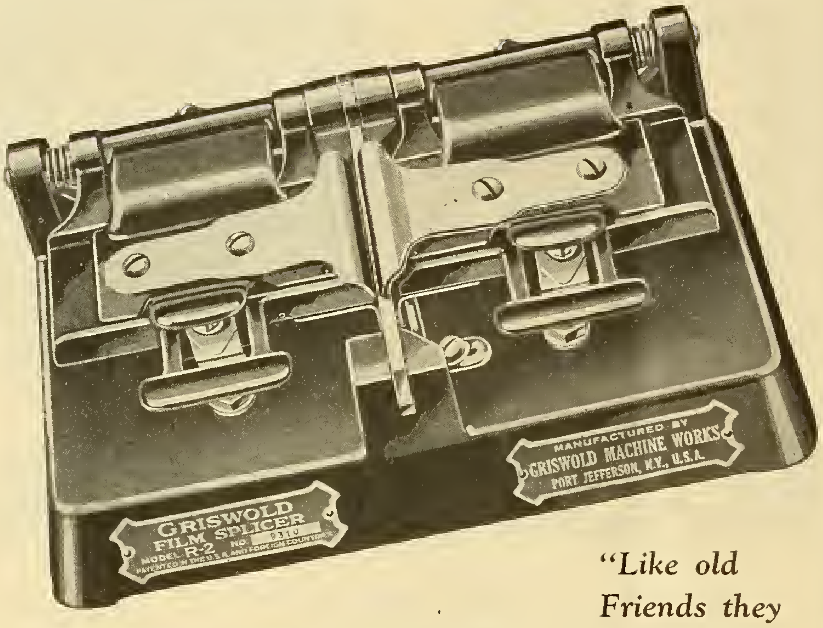
Note the comparison between the actual effects produced on the NEW GARDINER PERFORATED GOLD FIBER (*Seamless*) SCREEN and other screens. Can your theatre afford to be without the best? Install a GARDINER SCREEN now and see your patronage grow.

Other Gardiner Products

PERFECT PARTS FOR SIMPLEX PROJECTION MACHINES
REFLECTOR ARC LAMPS
MOTOR GENERATORS
TUNGAR RECTIFIERS
AUTOMATIC REWINDS
FILM TABLES
FILM VAULTS
and many other necessary motion picture accessories.

ALL QUALITY PRODUCTS

THE L. J. GARDINER CO.
935 GOODALE BOULEVARD COLUMBUS, OHIO



"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS
Port Jefferson, Long Island New York

F. S. C.
Optical Crown Plates
For enclosing Portholes of Projection Booths
PRECISION SURFACES
NO DISTORTION

S. O. G.
"IGNAL" CONDENSERS
Made of extra heat resisting Optical Glass
ALL SIZES
ALL FOCAL LENGTHS

Sole Distributors
FISH-SCHURMAN CORP.
230 East 45th Street New York City, N. Y.

15 Years of Successful Leadership

Simplex and Powers parts have been our specialty for years. Our gears, sprockets, rollers, screws and other projector head replacements are standard equipment in thousands of theatres. Fifteen years of successful leadership in this field is our guarantee of quality. Ask your dealer.

PRECISION MACHINE COMPANY
4601 West State Street, Milwaukee, Wis.

draw a variable or pulsating current from the power pack on account of the signal voltage coming in on their grids. This pulsating current would have to flow through the bleeder resistor and thus set up a pulsating voltage in it. This pulsating voltage due to any tube would be applied to the plate of a preceding tube and thus be fed back through the coupling circuit in the amplifier to the grid of the same tube producing the current pulsations. We would thus have a kind of "feed-back" or regenerative action, and the amplifier would oscillate and either distort the incoming signal, produce hum, or both. To prevent this, a condenser of the proper value must be connected between each tap of the bleeder resistor and ground, the common return. The proper location for these condensers is not at the bleeder resistor, but at the plate circuits in the amplifier. This does away with the pulsations being forced to flow through the leads connecting the amplifier and power pack, and thus produce coupling between stages in the leads themselves.

Another Scheme

An even better scheme is to isolate the plate circuits of the various tubes by feeding them through individual voltage-reducing resistors direct from the high voltage tap instead of from lower taps of the higher resistor. The scheme is shown in Figure 10. Here the plates of tubes 1 and 2 are fed through resistors R^1 and R^2, respectively. These reduce the high voltage to the rated value required by the tubes. The common feed may come from the high voltage tap 2 of the power pack shown in Figure 9. The pulsations in tubes 1 and 2 are led directly back to their respective cathodes by condensers C^1 and C^2, respectively, and do not have to flow through resistors R^1 or R^2, respectively, to any appreciable extent.

In this way the A.C. component of the plate current (current pulsations) of either tube does not affect the plate voltage of the other tube, and thus regeneration is avoided. This scheme can be varied in several ways, and is very effective for this purpose. The above resistors also act as filter units for the rectified plate supply. Thus any ripples in the current coming from the power pack have difficulty in flowing through R^1 or R^2, and the small amount that does come through is by-passed through C^1 and C^2, so that very little is applied to the plate of either tube.

Applied in P.E.C. Circuits

Such resistance capacity filters are sometimes used in circuits where very little current is required, as for photo-electric cells. Often in sound motion picture work the high plate supply has to be reduced to a much lower value, say 90 volts, for the photo electric cells, by the use of resistors, so that the latter may just as well be used for filtering purposes, too. A filter is shown in Figure 11, and consists of two stages. R^1 is the bleeder resistor, and R^2 and R^3 the filter as well as voltage-reducing resistors. C^1, C^2 and C^3 are the filter condensers, C^1 also serves to by-pass the A.C. component from either photo-electric cell, and thus prevents cross talk between the two projectors, as well as cuts down the length of circuit through which these components have to flow. Instead of C^1, a condenser is often put in the photo-electric cell circuit in each sound head. The advantage of a resistor over a choke coil is that the latter has a very low permeability to magnetic flux for low current through its winding, so that its inductance is low, and many turns would be required. Resistors are therefore cheaper and quite effective for small currents.

The ordinary rectifier tube has a vacuum within its glass envelope, and current flows solely due to the electrons emitted by the hot filament. Since these electrons are negative and mutually repellant, those that have already been emitted repel those about to be back into the filament. This increases the voltage required to pull the electrons over to the anodes (plates) and is known as the space charge. In the mercury vapor tube the mercury vapor present is ionized by collision with the emitted electrons, and forms additional electrons as well as positive ions. The latter are attracted to the cathode, and tend to pull out the electrons therefrom, thus overcoming the space charge, and lowering the voltage drop in the tube to about 15 volts. This drop is practically independent of the current flow, since as the current increases, the ionization increases at an even greater rate and the resistance, therefore, decreases, so that the IR drop remains about the same as before.

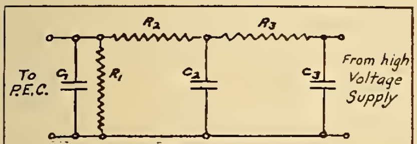


Figure 11.

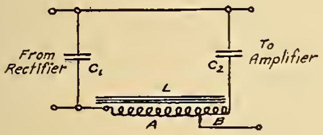


Figure 12.

A Popular Type

One type of filter choke extensively in use is the tapped choke shown at "L" in Figure 12. The number of turns in portion "A" is greater than that in portion "B", while "C^2" is greater than "C^1". Condenser "C^2" draws a ripple current of such phase through the choke as to neutralize the normal ripple that flows through part

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

It is no exaggeration to say that our rheostat is internationally famous.

Four out of every five theatres in this country use Hoffmann-Soons Rheostats *exclusively*.

A first class product, backed by reputation and guarantee. It always leads the field.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Specialists

RHEOSTATS

You Need to Know Sound!

And here's the way to learn —through RCA INSTITUTES

The day is rapidly coming when every projectionist in the country will need complete knowledge of sound! There's no avoiding the fact! So, isn't it to your future advantage to get ready now?

You can learn sound amplification in all branches at RCA Institutes—America's oldest Radio school. The sound course is thorough and practical. It includes, as well, the latest developments in public address systems and television. You can study either in New York or Chicago. Day and evening classes. Special summer session. Moderate tuition. Also special group rates. Coupon makes it easy for you to get full information. Clip and mail it *now*—before you forget! Address RCA Institutes, Inc., Dept. MP-6, 75 Varick St., New York—*or* 1154 Merchandise Mart, Chicago.

Trouble-shooting on sound reproducing

Courses also available in new "no obligation" plan for home study from New York School

RCA Institutes, Inc., Dept. MP-6
Home Office—75 Varick St., New York
Chicago Office—1154 Merchandise Mart

RCA INSTITUTES INC.
A Radio Corporation of America Subsidiary

Please send me complete details on sound courses.

Name ....

Address ....

Leadership is Progress

NATIONAL Projector Carbons hold recognized leadership for all types of projection equipment. They keep pace with the progress of the Motion Picture Industry. They meet or anticipate each new demand.

The new National S R A Carbons and Pre-Cratered High Intensity Carbons are recent improvements making possible better projection and steadier screen illumination.

Use National Projector Carbons in your theatre. You will find the steady brilliance of screen illumination pleasing to your audiences and a source of increased patronage.

NATIONAL
PROJECTOR CARBONS

. . . Sold exclusively through distributors and dealers. National Carbon Company will gladly cooperate with the producer, exhibitor, machine manufacturer or projectionist on any problem involving light.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division • Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York, Pittsburgh, Chicago, San Francisco

Your Job and Your Screen

Every projectionist knows he is expected to demonstrate constantly his efficiency by keeping his projection up to standard.

To do this your screen must be up to standard.

Scientific tests will easily demonstrate the superiority of Da-Lite Perforated Sound Screens. They are now being used in a majority of theatres in the United States and Canada. Many of these are getting old. We suggest you check your screens for efficiency.

Da-Lite will give you the satisfaction a craftsman always feels in possessing a fine tool—knowing it will make his work better and easier.

Inquiry regarding screens for any type of house gladly answered with a specific recommendation.

DA-LITE

DA-LITE SCREEN COMPANY, INC.
2723 N. CRAWFORD AVENUE, CHICAGO

BEST CARBON SAVER

are wise investments!!

$2.50 Each

Will pay for themselves in time in carbon saved and wear on lamp jaws. All sizes available.

Manufacturers of
Best Improved Spotlights
Best Rewind Pulleys

ASK YOUR DEALER
BEST DEVICES CO.
2108 PAYNE AVENUE CLEVELAND, OHIO

"A" alone and out through the load. Or we may say that "L" is an autotransformer of which "A" is the primary, and "B" the secondary. From the latter "C_2" draws a leading current, which is of such magnitude as to balance the normal ripple current tending to flow through "A" and the amplifier, so that through the latter very little ripple current flows. The scheme is due to Miessner, and is very effective, yet requires comparatively little iron or copper, and therefore reduces the cost of the filter unit.

This concludes the article on power packs. As stated before, lack of space precludes a more comprehensive treatment, but it is hoped that the information contained herein will be of value to the reader.

Fundamentals of Sound

(*Continued from page* 19)

by its action in a room where music is being played, for as notes of a certain frequency are struck some object such as a dish or picture will suddenly jump and emit a loud rattle. This is due to the fact that the natural period or resiliency of the object is such as to cause it to move backward and forward at the exact moment when the areas of compression and rarefaction in the sound wave impinge upon it.

An example of the effect of properly timed impulses is to be found in the action of a person pushing a child on a rope swing. Because of the length of the rope, the swing has a natural period of movement. If given a slight push and permitted to swing back and then pushed again as it starts forward, it requires very little energy to produce in it a motion of large amplitude—or in other words, to make it swing high. If the impulses are not applied at the correct moment the motion of the swing will be retarded instead of helped.

A common method by means of which this effect of sympathetic vibration in a body is demonstrated is that of two tuning forks which have the same period of vibration or frequency. One fork being struck and set into vibration, it emits sound waves which, by means of successive minute pushes and pulls set the other fork in vibration.

If two forks when at rest are struck simultaneously, the sound waves of the one will reinforce the sound waves of the other and the result will be a louder tone due to the fact that the areas of compression join each other to produce areas of greater compression and the areas of rarefaction join each other to produce areas of greater rarefaction, thus creating a sound wave of greater amplitude.

(*To be continued*)

S.M.P.E. Meeting

(*Continued from page* 17)

"Standards and Requirements of Projection for Visual Education," by Chauncey L. Greene, RKO-Hennepin, Minneapolis, Minn. Mr. Greene outlined the conditions for projection free from eyestrain, recommending in the case of auditoriums of unusual shape, a possible relocation of screen and seats to afford a more comfortable viewing angle.

A paper of more than academic interest to the projectionist was delivered by Mr. John Mauran of the Photophone Division of the RCA Victor Company. Mr. Mauran described the tools that the sound service man uses. Many of these are of special design and have found their origin in the exigencies of sound equipment servicing.

Mr. Charles E. "Chick" Lewis outlined for the Society a method by means of which it could be of greater service to the industry. The speaker stressed the fact that the field is unlimited and that great benefit might accrue through the establishment of a bureau as a clearing-house for new ideas.

A paper of wide general interest, doubly so to those unacquainted with the possibilities of the device, was that of Mr. Charles W. Barrell, Motion Picture Director of the Western Electric Co., on the subject of "Recording Artificial Speech in Motion Pictures." The paper presented a brief description of the mechanical voice box which replaces the natural larynx when that organ has been removed by surgery, and served to introduce a sound motion picture, "The Voice That Science Made," which not only demonstrated in a graphic manner the operation of the device, but showed it in actual operation. At the conclusion of the picture, a user of the instrument was presented to the audience, which at the time numbered more than two hundred, and addressed them in a voice that was not only amazing for its articulation and inflection but was clearly audible to everybody in the assemblage.

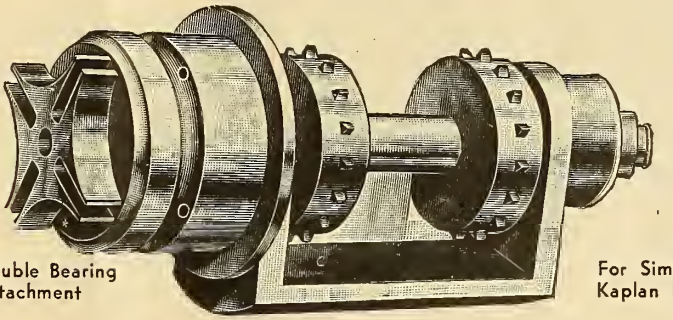
A few of the many other features of interest to the projectionist were the reports of the various committees. The report of the Projection Practice Committee was made by Mr. F. H. Richardson, in the absence of Mr. Harry Rubin, the chairman. The report of the Standards Committee concerned itself largely with the standardization of 16 mm. dimensions. It was this report that was referred back to the committee for further consideration. It is interesting to note that the report of the Progress Committee required 55 pages of manuscript text to cover the technical advances which have been made since the convention at Swampscott last fall.

HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.



Complete
$27.50

Double Bearing Attachment

For Simplex and Kaplan Machines

Our new price is $27.50

MACHINE PARTS

LAVEZZI MACHINE WORKS
160 N. WELLS STREET CHICAGO, ILL.

Stars, Cams and Sprockets of Every Description. Also Manufacturers of the Entire Double Bearing and Single Bearing Intermittent Movement Complete. Our Hardened Heat Treated Parts Cost No More Than Soft Parts. Established 1908.

for

Unexcelled Performance

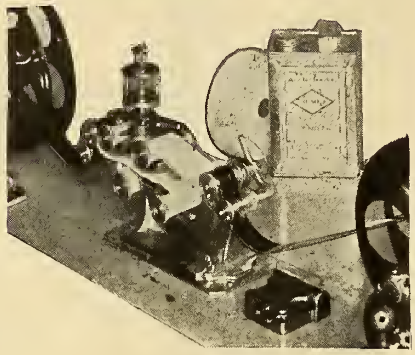
TELEPHOTO
PHOTOELECTRIC CELLS

For talking picture operation, it is essential that the tube should have a high signal output with an absence of "rush" noise or similar disturbance. . . . Telephoto Photoelectric Cells of the Caesium Argon type meet this requirement in an exceptionally high degree —for each cell is constructed under the most careful supervision of trained laboratory experts and is subject to a final test after having undergone a special ageing process.

MADE IN ALL TYPES AND SHAPES.
PAMPHLET ON REQUEST.

Telephoto & Television Corp.
133-135 W. 19th Street New York

Clean



Film

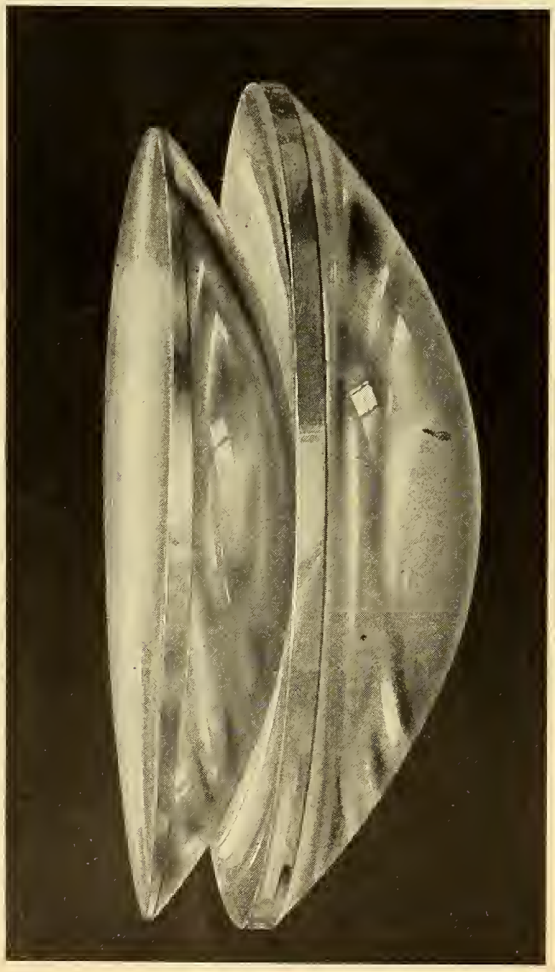
Think of sound equipment costing many thousands of dollars used to run dirty film! Imagine treating an audience in a million-dollar de-luxe theatre to streaky film and squeaky sound!

Audiences demand clean film

It can be avoided easily and inexpensively by using our WIPER-CLEANER together with our FILMEX CLEANING FLUID. This absolutely removes oil and surface dirt which is so detrimental to good sound and picture projection.

Write for our booklet.

Film Processing Machinery Corporation
354 West 44th Street
New York City, New York



The new B & L Condenser System (shown at left) used with the Super Cinephor delivers approximately 50% more light to the screen than existing condensers. That means 50% more brilliance—a 50% better show.

It's Part of Your Job

EVER figured just how big a part of *your job* the lens on your projection machine is? Ever figured that the best projection outfit ever made needs a Super Cinephor to put the show on the sheet in a way that makes you proud you're in the booth?

Plenty depends on that lens. The house has *got to be pleased* and only clear, sharp, brilliant screen images can please 'em completely. The show, the management, *YOUR job* depends on *the way the show goes on that screen.*

Get Super Cinephors into service to *protect your job,* profit the boss, and please the house . . . day in, day out and *every* night.

Ask your National Theatre Supply man about Super Cinephors or send the coupon for complete details.

(Interesting Note: The glass in Super Cinephors is *all* made in our own glass plant. There is positively no imported or purchased glass in Super Cinephors.)

BAUSCH & LOMB OPTICAL CO.
680 St. Paul Street Rochester, New York

Simplex-Acme
COMPLETE SOUND-ON-FILM UNIT

–the PROJECTOR *you have waited for*

This new Simplex-Acme Projector and Sound Reproducer is our response to a nation-wide demand for thrift in theatre operation. Here is a complete sound-on-film projection unit—the first to be offered at reasonable initial cost. It brings other outstanding economies, such as low cost for operation, minimum expense for upkeep and no established service charges for maintenance. For every theatre, except the very largest, the Simplex-Acme offers, besides economy, a remarkable improvement in perfectly synchronized projection and sound reproduction. A compactly designed, scientifically balanced complete unit that operates with far greater precision and smoothness than is possible with individual sound assemblies attached to regulation silent film projectors. This is your opportunity to replace your old projectors and sound attachments with the latest development of The International Projector Corporation and R.C.A. — the finest equipment ever offered and *at a price you can afford to pay!* . . . We are now ready to demonstrate this remarkable unit. *The Coupon* will bring you full information and a most attractive proposition. *Mail it now.*

FEATURING—

- A built-in Reflector Arc Lamp of latest type and ample capacity for screen distances up to 150 feet. A perfect optical alignment.
- R.C.A. Sound Reproducing Assembly of latest design, built-in; rugged in construction, rigidly mounted and compact in arrangement.
- Entire projector consists of separate assemblies, any one of which may be readily removed without disturbance to other parts.
- New, scientifically perfected lubricating system insures positive oiling of all rotating parts. *Simplex engineering throughout.*
- Compactness; sturdy construction. Entire mechanism simplified and refined — a sound projection equipment that meets the requirements of today.

Mail This Coupon to National Office Nearest You

National Theatre Supply Company:

Send full details about the new Simplex-Acme unit, with prices and terms. We are now using

____________ projectors with ____________
(make) (make)

sound equipment. Our throw is ____________ feet.

Theatre ____________

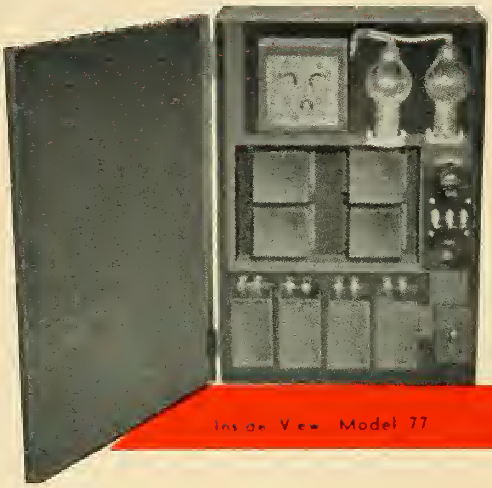
City ____________ State ____________

Signed ____________

National
THEATRE SUPPLY COMPANY

WHERE YOU BUY RIGHT!

ARE YOUR BATTERIES WEARING OUT?



Inside View Model 77

A guaranteed product. Satisfactorily used in the country's leading theatres.

a FOREST RECTIFIER

SOLVES YOUR BATTERY PROBLEM

GIVING YOU

BETTER OPERATION AT LESS EXPENSE

Regarding your power supply, you must make one of 3 choices. 1. Replace worn out, troublesome storage batteries. 2. Buy new equipment. 3. Modernize your present apparatus by installing all A.C. Forest Rectifiers, inexpensive and practical. Before making a decision, consider this fact: Forest rectifiers save current, are efficient, supply unfailing non-fluctuating current, require no attention or attendance, and are always ready for service. They eliminate all "A," "B" and "C" batteries.

Model 77 supplies 7½ amperes to exciter lamp and 1 ampere to amplifier filaments. We make a rectifier for every direct current requirement on sound equipment.

Front View, Model 25-25

Forest Rectifiers are recognized as Standard Equipment and are so specified in the majority of new installations and projection room changes.

AND NOW

A BRAND NEW FOREST RECTIFIER

for Good Projection Everywhere

A greatly improved rectifier—the result of years of experience and research is now ready. These new Forest Rectifiers will absolutely outperform anything ever offered before. Inexpensive to own, economical to operate, easy to install and positively quiet in operation.

Available in Model No. 30 up to 30 ampere capacity for one projector. Model 25-25, up to 25 amperes to one projector and an additional 25 amperes to second projector during change over. Model No. 45, up to 45 amperes to one projector available for either single or three phase A.C. current.

Model No. 6, up to 65 amperes, and Model No. 10, up to 100 amperes, both for one projector, are now available in three phase A.C. current only.

Model No. 15 is portable, 15 ampere capacity.
Model No. 20 is stationary, 20 ampere capacity.

Write for bulletins

FOREST ELECTRIC CORP.

Newark New Jersey

JUL 15

MOTION PICTURE PROJECTIONIST

d Delegate

...legate ...y of Chicag...
Reynolds of Chicago, Ill., Local No. 10 to act as ...rs.

International President Elliott resumed the Chair and introduced to the Convention Mr. Boone Mancall, Editor of the "Motion Picture Projectionist," a publication, which is supported to quite some extent by the members of our Operators' locals. Mr. Mancall delivered an interesting address, touching on the many changes that have transpired in this particular part of the theatrical industry in recent times.

... was no...

Chairman Elliott state...
...rts of ...

Thirty-first Biennial Convention of International Alliance, Columbus, O. Group, Showing W. C. Elliott and Other Officials

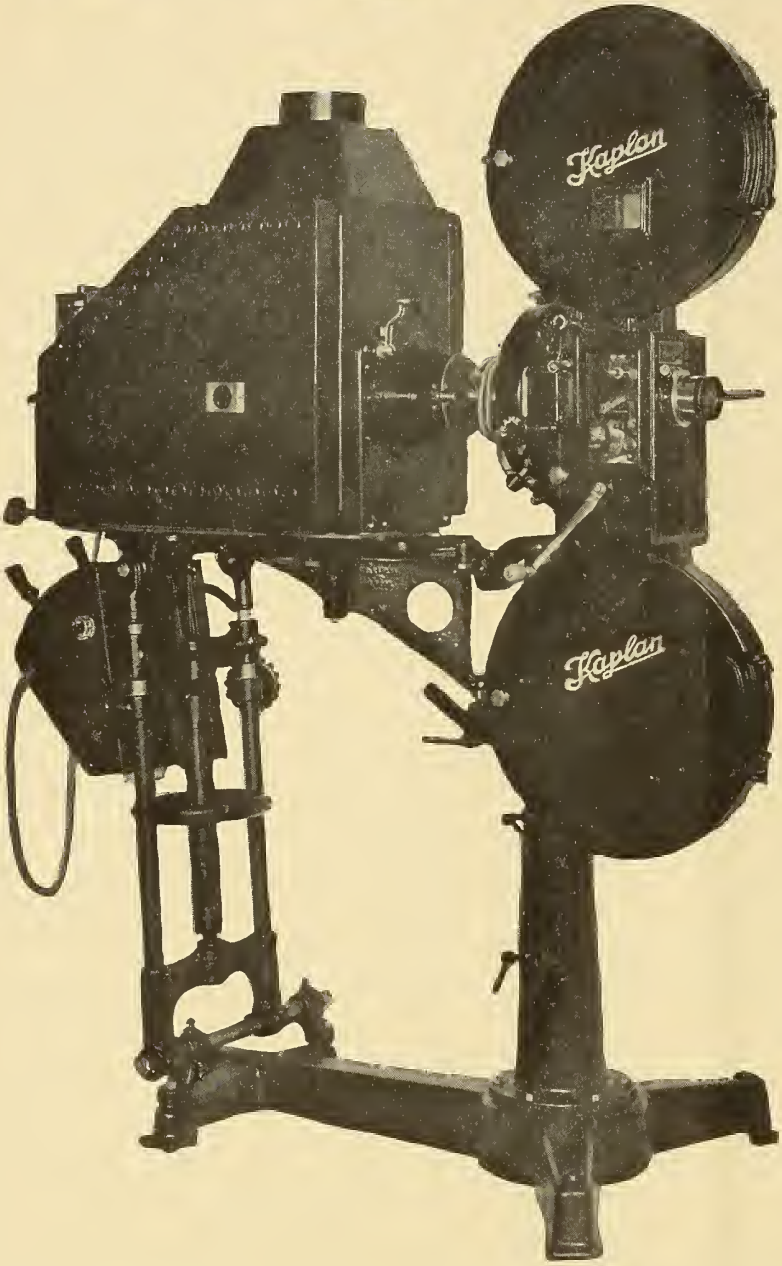
5TH YEAR OF PUBLICATION

Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.*
Editorial and Advertising Offices, 7 West 44th Street, New York City.
Entered at New York Post Office as second class matter, October 25, 1927.

Vol. 5 • No. 9
JULY, 1932
25c per copy, $2 per year

Kaplan

PROJECTOR



The Kaplan Projector has been standard equipment in many of the country's leading theatres for many years. Time has proven it to be a mechanism based on the soundest of engineering principles, both in design and construction.

Rigid — where rigidity is essential; no vibration; easy, smooth-running, noiseless, and long-enduring, it stands as a monument to the best and most modern factory methods and engineering work. Performance over a long period of time is the acid test of all good product. Time and performance have been the best salesmen for the Kaplan Projector.

An Engineering Product

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue ·:· ·:· New York City

MOTION PICTURE PROJECTIONIST

July, 1932 Vol. 5, No. 9

CHARLES E. BROWNELL, Editor
Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* J. E. Robin, *Equipment;* W. W. Jones, *Theory;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. Entered as second class matter Oct. 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth St.
Melbourne, Australia.

Advertising Manager
Boone Mancall

Editorial & Advertising Office
7 West 44th St.
New York City.

S.M.P.E. Committee Reports on Resurfacing Screens

Resurfacing of motion picture screens by theatre personnel usually leads to unsatisfactory results, according to a report of the Projection Screens Committee of the Society of Motion Picture Engineers. Tests made by the committee showed that less reflection properties are restored to the screen when resurfaced by the theatre than when they are resurfaced by the manufacturer.

The tests showed that the reflection factor of 85% possessed by a new diffusing type screen is reduced to 60% after two years of use. When this screen was refinished by the exhibitor its reflection factor was increased to 65%, but when the same screen was refinished by the manufacturer the reflection factor was increased to 82% or only 3% less than its original factor of reflection.

"At first," says the report, "we were hopeful that surfaces could be renovated satisfactorily by spraying and painting with screens in place. However, it is our present opinion that resurfacing has not been generally successful as yet."

THEY STARTED WITH

"INKIES"

AND ENDED WITH

DAYLIGHT

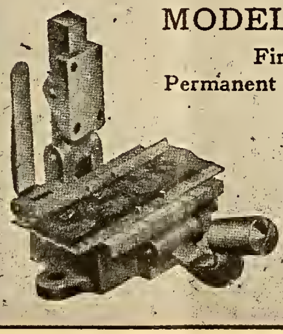
●

WHEN first announced, Eastman Supersensitive Panchromatic Negative was used chiefly with incandescent lighting. It was found, however, to be equally valuable under arcs. And now cameramen are finding it ideally suited to *daylight* shots, particularly when it is provided with the non-halation gray backing. Expert in every branch of cinematography, Eastman Supersensitive "Pan" is an all-purpose negative, the advantages of which are felt all the way from the lot to the screen. Eastman Kodak Company. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN SUPER-SENSITIVE
PANCHROMATIC NEGATIVE (GRAY-BACKED)

Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

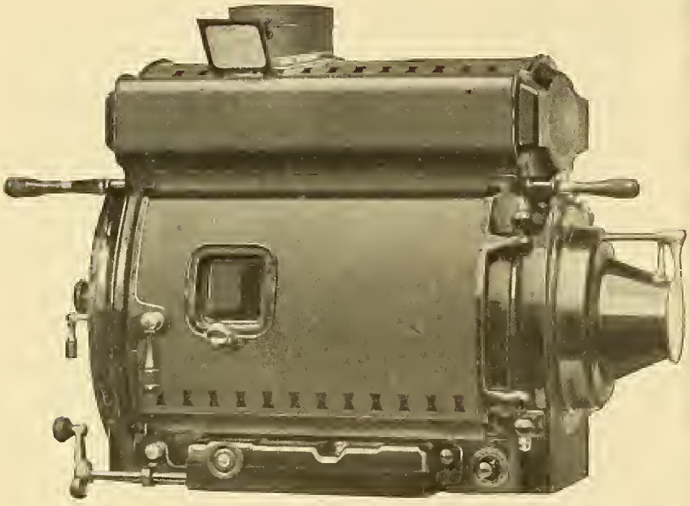


First-Class Results on New or Old Film
Permanent Gauge No Adjusting
FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS
Price $6.00
GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers

The New

Brenkert

High Intensity
Reflector Lamp



Air-cooled mechanism—Plain negative carbon — Oil lubrication to all bearings — Pyrex mirror reflector — 65 to 85 amperes capacity — unit construction — and many other features assuring excellent screen results, ease of operation and low maintenance cost.

Distributed by Independent Supply Dealers

WRITE FOR LITERATURE

A
Brenkert
PRODUCT

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

Simplex-Acme

- Built-in Reflector Arc Lamp, latest type with ample capacity for screen distances up to 150 feet. Perfect optical alignment.
- R. C. A. Sound Reproducing Assembly, latest design, built-in; rugged in construction, rigidly mounted and compact.
- Entire projector consists of separate assemblies, any one of which may be removed without disturbance to other parts.
- Simplex engineering throughout. New, lubricating system insures positive oiling of all rotating parts.
- Entire mechanism simplified and refined — a sound - projection equipment that meets every requirement.

—a UNIFIED
Sound-on-Film Projector

A compact designed, scientifically balanced complete projector unit that operates with far greater precision and smoothness than is possible with individual sound attachments on regulation silent film projectors. The Simplex-Acme is the latest scientific development of The International Projector Corporation and R. C. A.—the finest equipment ever before offered and priced at a figure any theatre can afford to pay. It meets the requirements of the most critical projectionists and engineers and effects substantial economies in operation. . . . We are ready to demonstrate this remarkable unit. *The Coupon*, below, will bring you complete information, without obligation. *Mail it today.*

NATIONAL
THEATRE SUPPLY COMPANY

YOUR LOGICAL SUPPLY HOUSE

MAIL THIS COUPON TO NATIONAL OFFICE NEAREST YOU

Gentlemen: Send full details about the new Simplex-Acme unit. We are now using..........................projectors with................
(make) (make)
sound equipment. Our throw is................feet.
Theatre ....
City .... State..................
Signed ....

As The EDITOR *Sees* IT

¶ *A Statement of Policy*

AT the end of five years of continuous service to the motion picture projection craft, the MOTION PICTURE PROJECTIONIST is still enjoying the respect of the entire motion picture industry and in particular the esteem and loyalty of many thousands of subscribers. It is my belief that this publication will continue to do so as long as it maintains its policy of education on craft equipment and craft technique.

It will continue to receive the support and interest of all International officers and officers of local unions no matter who they are from term to term as long as we do not presume to meddle in their organization affairs or take sides in organization disputes involving personalities and politics.

We will continue to publish a successful and useful paper only so long as we do not ally ourselves with any one group, clique or personality. Only in the disinterested field of educational service can we be of use to our readers and advertisers.

This same theme was the subject of my address before the delegates at the Convention in Columbus.

I felt that the time had come for a restatement of our time-honored policy.

In the last five years projectionists have passed through one crisis after another. The supreme test came with the introduction of talking pictures. With the rest of the world the craft is feeling the pinch of hard times. But the last five years revealed them as eminently capable of caring for their own best interests. They have never lacked proper leadership from within their ranks.

So far as I know the International office has never asked the advice or assistance of anyone outside the ranks of organized labor. Within my recollection the same holds true of the local unions in the I. A.

Gratuitous advice, of course, is always pitiful.

This publication has faith in the International Alliance and in every local union that is part of it. We have faith in the ability of the leadership to carry the organization along safely and successfully to greater heights of organization and to a continuous betterment of its membership.

The basic interest of this publication is in the utmost good and welfare of the organized projectionists of the United States and of Canada. But it believes that organization matters can be left securely in the hands of the duly elected leadership.

On the other hand, the MOTION PICTURE PROJECTIONIST will do its share toward the betterment of the craft by sticking closely to its single aim: the gathering and dissemination of information and educational material.

As the I. A. organization works for a betterment of conditions the MOTION PICTURE PROJECTIONIST will continue to work for a better understanding of the technical side of projection.

With this sort of policy every future convention will see this publication becoming more and more an indispensable part of the work of the projectionists who are part of the I. A. T. S. E.

¶ *A Step in the Right Direction*

OUR attention has just been called to a general ordinance respecting the operation of motion picture equipment which has just been passed by the Common Council of the City of Beaver Dam, Dodge County, Wisconsin. The ordinance reads in part:

"Section 1. In all theatres, places of amusement and other public places where motion picture machines are used for the projection of motion pictures, there shall not be less than one operator of not less than twenty-one years of age for each projection machine used or operated.

"Section 2. It shall be unlawful for any owner, manager, corporation or association having in charge such theatre, place of amusement or other public place where motion picture machines are used, to permit one man to operate more than one such machine."

Heavy fines and imprisonment are provided for violations of any provisions of the ordinance and infractions of the code may even result in revocation of the theatre license.

In view of the recent movement afoot in certain quarters to abrogate the two-man ruling in favor of one man in the projection room, it is highly encouraging to find a community with sufficient enterprise and interest in the safety and welfare of its citizens to take active measures to protect their rights in regard to this important matter. The move is not only a step in the right direction but it carries with it a suggestion to local unions in localities where the two-man ruling is menaced or not enforced.

The Common Council of Beaver Dam is to be congratulated upon its public spirit and foresight.

Boone Mancall

Some Applications of the Selsyn Motor

The Interlocking Principle as Utilized in Motion Pictures

By O. L. Dupy

Within its own particular field the industrial applications of the Selsyn motor appear almost limitless. Mr. Dupy discusses the theory underlying the operation of such motors and describes some of the specific and practical uses to which they have already been assigned in motion picture work. The author is Recording Supervisor of the Metro-Goldwyn-Mayer Studios at Culver City, California.—THE EDITOR.

SINCE the days of our youth we have had the telegraph, the telephone and other tele-gadgets, but no convenient commercial tele-motion. Probably our first desire for tele-motion came when, lying in bed on a cold winter morning, we wanted to close the windows and turn on the heat without leaving our warm beds. Necessity—not to mention comfort—is the mother of invention. In many cases levers, gears, long line shafts, cables, and such mechanical movements have been used to solve various problems in moving something at a distance from the operator.

Almost everyone who had anything to do with the projection of Sound Pictures has had the desire to be able to sit in the theatre and reach up into the projection room and operate that volume control—the proper amount at the proper moment—to give the customers a good show. This is necessary because the volume necessary for proper sound projection changes with the size and location of the audience. Also, volume range of the medium on which the record is made is sometimes not sufficient to permit the original record to have the proper volume change to fit the various scenes through a picture.

Necessity for Remote Control

If the projectionists had nothing to do but watch the picture, a prearranged set of cues might be worked out, with a little rehearsing that would permit the sound to do its best in helping to make a good show. The fader, or volume control, might be located in the theatre, and the audio leads brought to it from the amplifier in the projection room, but in some systems it is impractical, if not impossible, to have long leads in the volume control circuit.

The Selsyn generator and motor system (Selsyn, the General Electric trade name for self-synchronous motors, in synchronism with themselves; in step, or "interlocked," with each other) fits this tele-motion need very nicely. One unit—the master unit—is connected to a dummy fader which can be located anywhere in the theatre, or be portable. The other unit is connected to the actual fader in the projection room. Figure No. 1 shows such a mechanical setup.

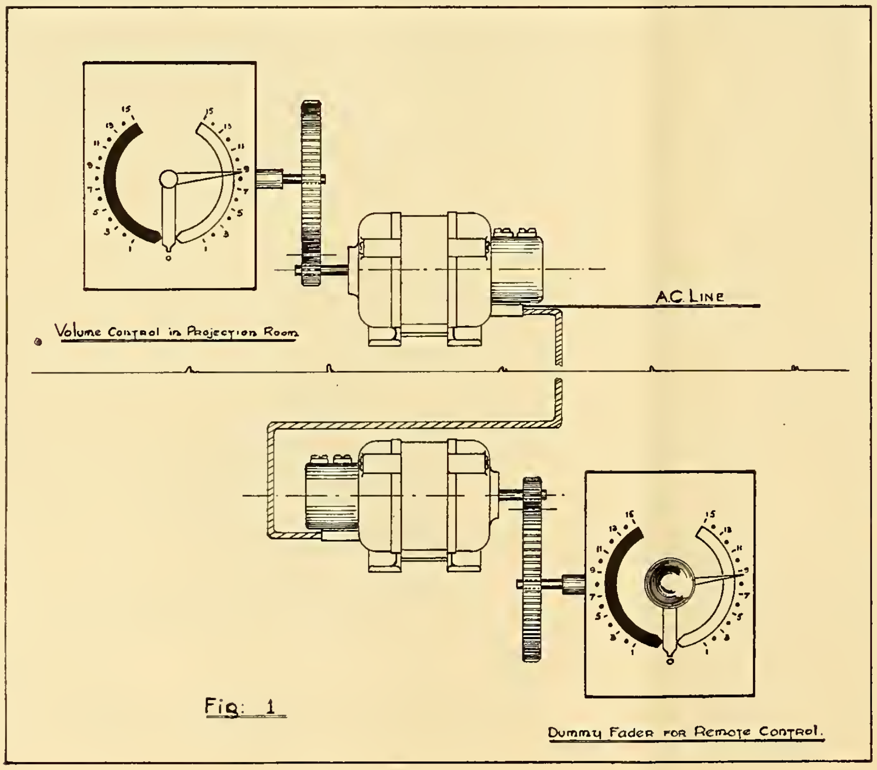

Volume Control in Projection Room
AC Line
Dummy Fader for Remote Control.

Fig: 1

The reason for the gears shown is that in order to transmit any movement over this system, the master unit must be rotated a few degrees before any appreciable amount of power is exerted by the motor connected to it to follow in step with it. This lag or back lash might be troublesome if the motor unit is loaded fairly heavily by the fader.

By gearing up to the master Selsyn Unit from the dummy fader, a small movement of the dial produces a large movement of the unit. At the fader end, gearing down from the Selsyn motor unit to the fader reduces the necessary torque that the unit must produce to turn the fader. The Selsyn motors have ball bearings throughout and very little power is lost through gearing. A very smooth and accurate system results. The gears used in the first such setup that I know of looked as though some idle projection machine had lost some of its inner-works. But the remote control fader worked and orders for spare parts put everything in shape again.

Other uses for this system will very likely be found in the theatre, such as operating lighting effects—colored or otherwise—where the lights are mounted in some inaccessible place.

Other M. P. Applications

We have been discussing the use of the Selsyn motor for the control of sound in its final state, that is, when it is being shown to the public. But in the various stages of making sound pictures the interlocked motors play a much greater part. First in shooting the picture, the cameras and recording machines are driven by units similar to the small single phase one described. These are larger and excited by three phase A.C. power and are driven by a motor. The master unit, or distributor, to which all these units are connected, is capable of delivering several horsepower. The shooting of a picture can be, and is, done with synchronous motors driving the cameras and recording machines. But in re-recording, where the sound track for release is often a composite of several dialogue and sound effect tracks, interlocked motors must be used.

The projection machine, the recording machine and the numerous sound heads with their different sound tracks must start on their start marks—accelerate up to speed and run in step. On several occasions eight sound heads—a projection machine, a film recording machine, and a disc recording machine have been connected to one master distribu-

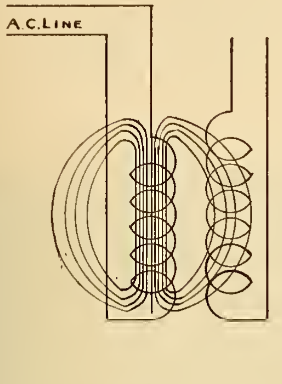


Fig 2A

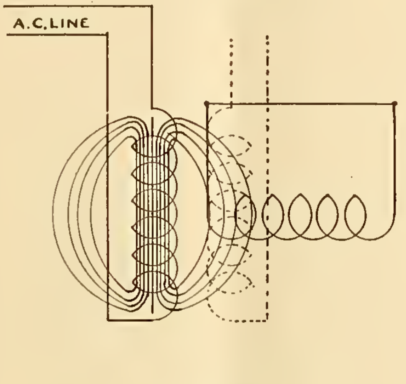


Fig 2B

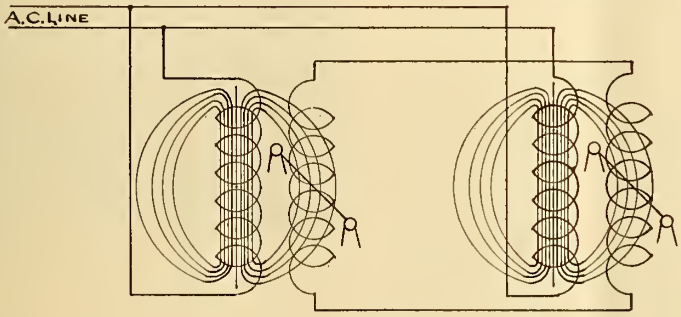


Fig 3

tor. Even more units have been used on special setups.

In construction the interlocked motors are similar to induction motors but are rated and controlled in a special manner for this service. In fact the polyphase and capacitor types are nearly identical to polyphase wound rotor induction motors and can be used as such.

Theory of Operation

In describing the operation of the small single phase type, let us consider a coil connected to an alternating current line and a magnetic circuit in which this coil is setting up an alternating field. A second or secondary coil in this same field will have an alternating voltage induced by this alternating field (Figure 2A). If we close the circuit of this second coil current will flow through it. This current will in turn produce an alternating field through the magnetic circuit which opposes the field set up by this first or primary coil.

These opposing fields produce force and if one of the coils was pivoted, it would place itself in such a position that there was no flux passing through it that was produced by the other coil. This, of course, would mean that the secondary coil would end up at right angles to the field of the primary coil, consequently no flux would be passing through it, no voltage induced, no current flowing, no force. (Figure 2B.)

In the next step we will consider two of the above coils, and magnetic circuit arrangements. If we connect both primary windings to the same line similar fields will be set up in each magnetic circuit. Then if we connect the respective leads of the secondary coils together (Figure No. 3) and they are in the same respective positions in their fields, the voltage induced in each is of the same voltage and polarity and no current will flow and no force will be produced. But if the coils are pivoted on bearings so that we can rotate one of the coils in respect to its field, the amount of flux passing through it will change and current will flow through both coils due to the difference in voltage.

Why They Interlock

This current will produce a force tending to replace the moved coil back to its original position and also a force in the other coil tending to move it to a similar position in its own field. In this way the two systems would move in synchronism or be interlocked with each other over a limited portion of a revolution because the strength of the interlock would be in proportion to the flux passing through the coils. Consequently the interlocking force would be zero when both coils were at right angles to the field setup by their primary coils.

In order to produce interlock torque throughout a complete revolution it is necessary to distribute one of the windings completely around a circular magnetic circuit. In actual construction the primary winding is the conventional single phase induction motor winding. The secondary winding is distributed in slots around the stator and connected identically the same as a three phase motor or generator winding (Figure No. 4) although there is no three phase power generated or three phase action in its operation.

The field from the primary winding is always passing through some parts of the secondary winding regardless

(*Continued on page* 29)

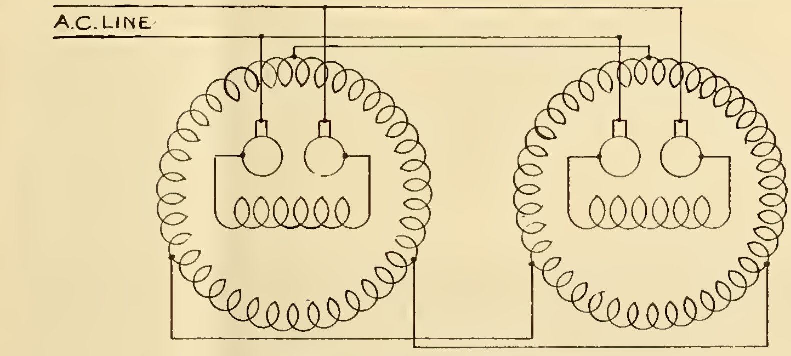


Fig4 Single Phase System

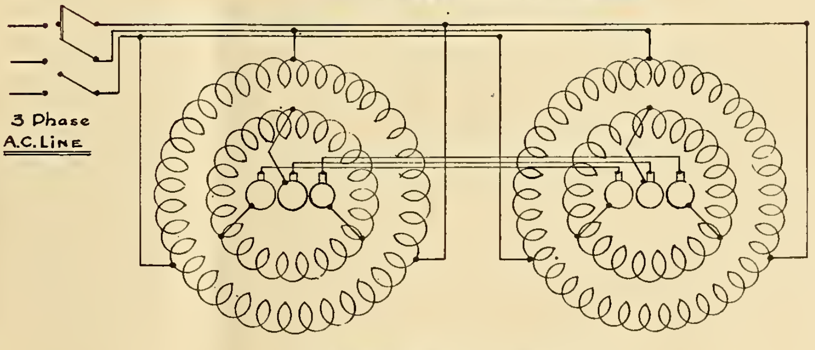


Fig 5 - Three Phase System

Motion Picture Film in the Making

By FRANKLIN COURTNEY ELLIS

The third and final installment of Mr. Ellis's informative account of the ingredients, processes, and historical background of motion picture film concerns itself with certain of the products and by-products of other industries which contribute their quota to the perfecting of film. The MOTION PICTURE PROJECTIONIST *wishes to take this opportunity to express its gratitude to Mr. Ellis for his genuine contribution to the literature of projection in this engrossing story of Motion Picture Film in the Making. The author is associated with the Eastman Kodak Company of Rochester, N. Y.*—THE EDITOR.

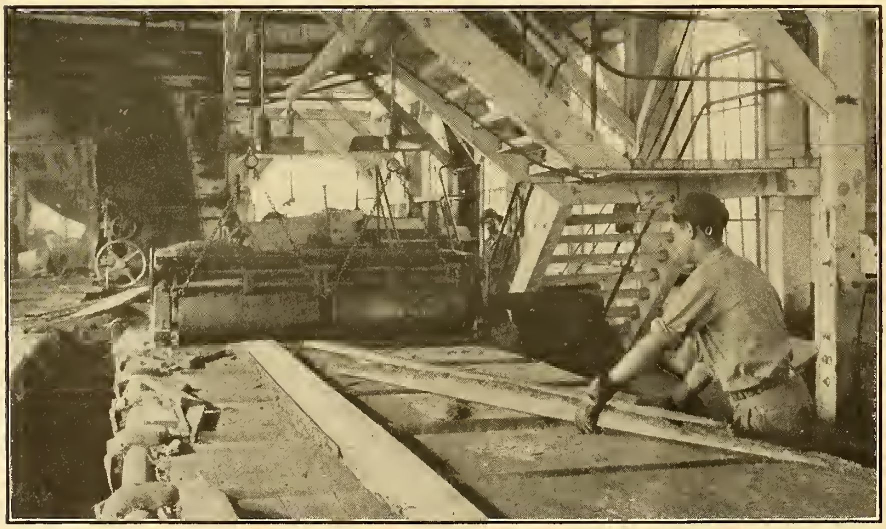
Part III.

MOTION picture film, famous in its own right, has also some notable cousins and some interesting ancestors. Projectionists may top off their fuller acquaintance with the physical medium of the motion picture art by examining some of film's surprising relationships.

Film's ancestry reaches back nearly two centuries, through a chain of photographic materials recognizable as forbears of the present transparent, flexible film only because their common object was to record light images.

We may also fancy, as motion picture film's progenitors in a more immediate sense, the ingredients of film. Those who have followed this brief series of articles on film manufacture will recall reading in an earlier part a list of the far-collected raw materials—but the "case history" of at least one substance entering the manufacture of film is sufficiently curious to warrant further description.

Film's cousins, as here imagined, are groups of commercial products which are chemically akin to film or to its raw materials but which are concerned with the affairs of projectionists only as curiosities—and because extension of the film industry's scope into related fields increases the ability to make better film. The relatives of motion picture film include such widely separated materials as chicken feed and artificial leather.



The Sort of Wood From the Sawmill That Goes Into Retorts

Early Work

Motion picture film began its remarkable career some time during George Washington's lifetime, in the form of a surface of silver nitrate and chalk spread by a German named Schulze. This crude beginning of definite photographic experimentation produced vague images, but promptly lost them again for lack of any means of "fixing." One of the English pottery-making family of Wedgwoods later tried his hand at the problem and so did Sir Humphry Davy, a versatile English chemist. Their results were perhaps less crude, but no more permanent, than those of Schulze.

Daguerre, the first name in photography which everyone knows, was a French painter whose laziness revolutionized the world's pictures. To save himself the tedious necessity of sketching, he studied the possibilities of photography and succeeded in making good photographs that remained as they were taken. The discovery of "fixing" by the English Herschel permitted Daguerre to achieve the latter result.

Earliest Sunlight Picture of Human Face. Original Daguerreotype Taken in 1840

Daguerre's medium—the first serious historical ancestor of motion picture film—was a silver plate, treated with iodine to give a light-sensitive surface of silver iodide. The famous Frenchman's process of causing mercury vapor to adhere to the light-affected parts of the plates, thus imaging the light areas of the picture, is less interesting than the observation of Daguerre's plates as predecessors to the many modern millions of film feet.

Evolution of Negative

Negative processes came next. Daguerre's had been a positive process. Paper, and then glass plates, were used, but with both materials it was necessary to take the picture while the emulsion was still wet. That necessity was very confining to an ambitious art like photography, and eventually the progress of invention yielded gelatine dry plates. George Eastman's start in photography was as a manufacturer of dry plates, and his first invention was an apparatus for coating dry plates mechanically.

So far as the emulsion goes, the gelatine dry plates of 1880 were comparatively modern. Speed, color sensitivity, and numerous other important refinements have been added by the scientific forces which the photographic industry has marshaled over the past half century, but the fundamental emulsion-making principle of suspending silver salt grains in gelatine remains the same.

As for the film base, George Eastman was the outstanding man to realize—and he realized it immediately upon giving serious consideration to the problems of photography—that glass plates were retarding photography's progress; that a light, unbreakable material to carry the emulsion would be necessary if photography were to become widely useful and adaptable.

Eastman's first attempts to make a film involved a paper base in a rollable form. The first Kodaks used such a film. The paper negative was prepared for printing either by greasing or by stripping off the emulsion layer and mounting it on glass.

But, obviously, paper was not the perfect film that Eastman sought. At the time when he was improving paper film, Eastman was also directing experiments toward the production of a film support transparent as well as flexible. The motion picture industry is testimony to the success of these experiments. Edison's order for a piece of the new film, back in 1889, is still in the files of the Eastman Kodak Company. That first piece of film bought from Eastman showed Edison that the new discovery was the "missing link" in a motion picture system as well as a radically new material for photography.

Embraces Many Fields

The previous articles of this series have shown that photographic manufacture is amazingly delicate and diversified. It is a paradox that as size and versatility of product have multiplied the complexities of photographic manufacture, ingenuity and organization have simplified the processes. Modern engineering, modern research, modern economics have kept within the bounds of control an industry characterized by a vast mass of detail.

Advanced methods peculiar to the photographic industry have kept one step ahead of the manufacturing difficulties introduced by each new improvement in motion picture materials. One hundred types of film—the stock in trade of the typical film manufactory we have been surveying—give us a clue, by their very number, to the problem involved, without even any thought of a subject related to manufacturing: raw materials.

But the film industry has to think of raw materials. Film can be no better than its raw materials. Assurance of raw material quality has been one means of reducing complex variables in film manufacture.

Cotton is easy enough to get, once the best variety for film use has been determined by long experimentation and the standard to be met has been established. Most of the other raw materials of motion picture film also are standard chemical materials—although our plant typical of the film industry has to make certain of its own raw materials because the best available commercial product is not pure enough for film-making requirements, or because a sufficient and regular supply can not otherwise be obtained.

One such case carries with it the story of a related industry, large in its own right, and introduces some of film's "cousins." The raw material in question is wood alcohol.

Motion picture film contains no wood alcohol, and yet very large aggregate quantities are used in film manufacture. No mystery lies behind that statement. Wood alcohol is used to dissolve nitrated cotton, but it is driven out of the film "dope" as heat dries the solution into sheet film.

Chemically pure wood alcohol—just one material used in film making—was important enough in the manufacturing economy to cause the largest photographic manufacturer to set up extensive lumbering operations in the forests of four states, to build a railroad system, and to establish a plant for turning waste wood from the forest and from the sawmill into chemically pure wood alcohol and other useful products. It is interesting to keep in mind that such a remote and far-flung industrial operation carries on with one objective: to keep the narrow strip of film clicking its way successfully through the projectors.

In the lumber business only about 40 per cent of the average tree is utilized as lumber. Part of what is left is used in other ways. For instance, sawdust stokes the fires to run the machinery of the average sawmill. Much of the rest is waste—but what is waste for the lumber industry is raw material for wood alcohol and a number of other products. The lumberjack slashing limbs from a felled oak on a Tennessee mountainside may not even realize it, but the limbs he removes and loads on a mule-drawn sledge play a part in the movie show he sees on Saturday night when he goes to town. So too the rounded slabs sawn from logs in the company's sawmill in the process of squaring up lumber for the market.

Here a large lumber business is merely a by-product. What interests the film maker is the "waste" wood which he distills into pyroligneous acid, reputedly the stuff with which Egypt embalmed its mummies.

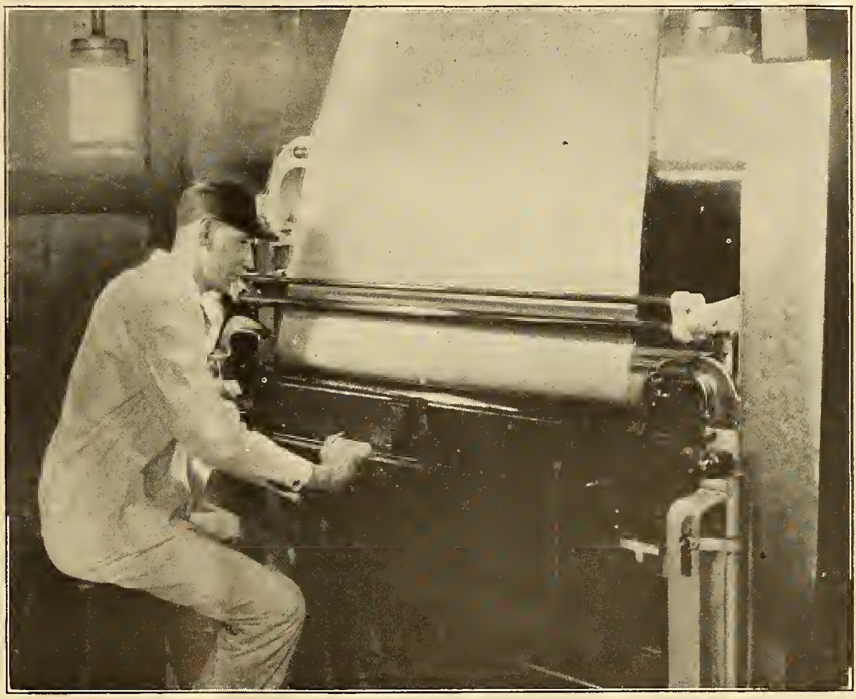
Charcoal, the residue after distillation, is an unusual "cousin" of motion picture film, but as a product of this photographic subsidiary, it is charcoal with a higher education. Even the dust raised in screening out the various sizes of charcoal is collected by a vacuum system for briquetting into dining car fuel that permits projectionists' meals when they travel to be cooked over longer-burning coals. The chickens broiled for those meals may also have been fed powdered charcoal that was a by-product of the film industry.

A Product of By-Products

Dividing pyroligneous acid into chemically pure wood alcohol and other "solvents" for film making and into wood pitch and creosote oils—by-products—is less remarkable than what happens to the third general derivative of pyroligneous acid—acetic acid.

Acetic acid was comparatively unimportant in the whole scheme of the film industry when this source plant for wood alcohol was established. The alacrity with which a movie-conscious world has taken to personal motion pictures, together with the greater use of X-rays since the war, has in-

(*Continued on page* 29)



In Coating Film Base, Dim Colored Light or Total Darkness Is Required. The Illustration Shows the Front of a Machine for Coating Emulsion on the Film Base. Each of These Machines Is Several Hundred Feet Long.

Noise and the Reproduction of Sound

By S. K. Wolf and J. E. Tweedale *

Great as are the difficulties which have been met and overcome in the recording and the reproduction of sound, the problem does not end here. Given the best of sound records and the finest of reproducing equipment, there still remain inherent in the theatre itself certain factors, some of them well-nigh uncontrollable, sufficient to destroy all semblance of fidelity and auricular illusion. In the article which follows consideration is given to the problem of theatre noise and its relation to the reproduction of sound. The material possesses added interest at this time in view of the fact that Mr. Wolf and Mr. Tweedale are co-authors of a paper on this important subject which was delivered at the recent Spring Meeting of the S.M.P.E.—The Editor.

It is a strange but incontrovertible fact that any average audience will accept infinitely more in the way of garbled speech from a speaker who is physically present on the stage than it will from a loudspeaker horn. Thus it was in the old days of the silent motion picture that the character of the average performance usually precluded the necessity for acoustical considerations and even in the larger houses where the picture program was often interspersed with vaudeville, little or no attention was accorded the now universal question of acoustics.

With the introduction of talking pictures, however, it became immediately obvious that good acoustic conditions must of necessity obtain in the theatre if the patron is to derive maximum pleasure from the program. In the wisely planned and the carefully maintained house of today, therefore, consideration is given to the restriction of reverberation time within acceptable limits, to the reduction or the elimination of objectionable noise sources and to intelligent and consistent control of the volume of the sound emitted by the stage speakers. The result of this program is apparent in the marked betterment of listening conditions and in a lessening of the previous aural discomfort and strain under adverse acoustic conditions.

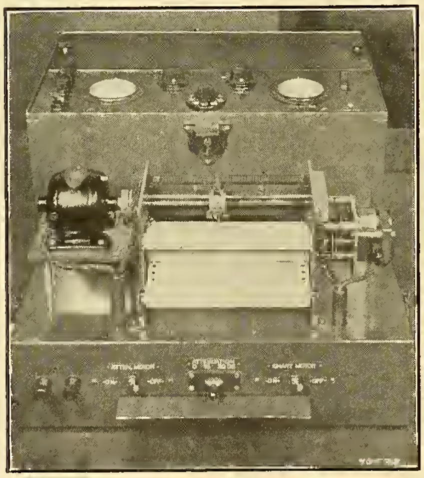


Fig. 1. Automatic Level Recorder

Noise Reduction Problem

The problems involved in the correction of reverberation time in order to secure optimal conditions are now well understood and much good work has been accomplished, but the theatre noise phase of the problem has presented numerous difficulties. The situation may be largely attributed to a failure to appreciate its effect and to an inadequate understanding of the factors influencing noise reduction.

For all practical purposes noise may be defined as unwanted sound. It produces two general effects, psychological annoyance and, under specific conditions, impairment of the hearing faculties, particularly in the interference with sound which it is desired to hear.

The psychological effect of noise, being a function of the emotional constitution of the individual and his reaction at a particular moment, does not lend itself to objective study. However, the effect of noise interference upon the hearing faculties can be readily measured objectively and in the case of speech sounds it is rated in articulation percentages. Studies by Fletcher and Knudsen have shown conclusively the effect of noise on the impairment of the interpretation of speech.

In the case of reproduced music, the effects of noise cannot be readily expressed except in terms of frequency masking. This is a function of the frequency composition of noise and the frequency range of the reproduced music.

Its Increasing Importance

With the steady improvement in sound recording, involving in particular greater volume range, extraneous noise in the theatre where the recording is reproduced is becoming an increasingly important factor. The noise referred to is, of course, that residual or ambient in the theatre and not that which may be present in the reproducing system.

The reason that noise present in the theatre is more detrimental in the case of greater volume range recordings is due to the fact that these later recordings, because of the elimination of surface and background noise in the recording and reproducing systems, permit a lower intensity range. It is apparent, therefore, that the residual or ambient noise in the theatre must be reduced concurrently with the background noises of the reproducing system if this band of low intensity sounds is to be fully utilized.

An instrument known as an automatic level recorder (Fig. 1) has been developed recently by the Bell Telephone Laboratories. The records shown in Fig. 2A and Fig. 2B, which were made by means of this device, demonstrate the effect of noise in reducing the benefits of wide volume range recording.

The intensity level chart in Fig. 2A was made of a wide volume range recording with no ambient noise present. A clear definition of all the low intensity sounds is obtained and it is obvious that an auditor could enjoy the full volume range with no great aural difficulty. On the other hand, if we examine Fig. 2B which was made of the same recording under precisely the same conditions, with the exception that it was reproduced in the presence of noise, it will be seen that this presence of noise has seriously impaired the effectiveness of the low intensity range with a resultant loss of intelligibility and enjoyment.

It is to be understood, of course, that even in the presence of the noise indicated in Fig. 2B, it is still possible to distinguish and interpret speech and music, but this interpretation would be accomplished with difficulty and require close attention with a consequent loss of enjoyment which the program might otherwise afford.

Two General Classes

There are two general classes into which theatre noise sources may be divided. The first includes those noises which are produced external to the theatre and the second those which find their origin within the theatre and are incidental to its operation. Foremost among those noises in the first class are those of street traffic, railway or other similar forms of transportation and industrial establishments.

An acoustic survey recently conducted in New York City shows that the average street noise level occasioned by traffic is approximately 60 to 70 db. depending upon the nature and density of and the proximity to traffic. In addition, momentary peaks of varying duration of 80 to 85 db. are encountered, and in a few isolated instances measurements have been made indicating street noise levels as

---

* Electrical Research Products, Inc.

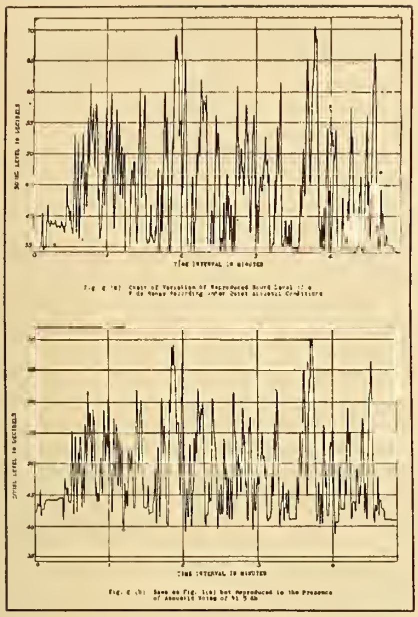


Fig. 2. A (Upper) Fig. 2. B (Lower) Intensity Level Charts

high as 95 db. The average street noise level in suburban locations may be considerably less than these values but the momentary peak values will probably still be representative.

In view of this high level of external noise it is apparent that to remain below the maximum internal noise level the theatre structure should have a transmission reduction factor of from 35 to 40 db. in order to overcome average traffic noise. In severe cases the factor will be as high as 60 to 70 db.

Not many existing theatres can satisfy these stringent requirements except for average street noise conditions. Reasonable reductions in the entrance of extraneous noises are possible, however, in the theatre of average construction by attention to details and the modification of some parts of the building structure. Fire exit doors, for example, have been found to be frequent offenders in the admission of extraneous noise and an appreciable improvement has followed the installation of better fitting doors of heavier construction. The use of additional sets of doors and acoustic absorption treatment in shallow entrances leading directly off the street have been found to aid appreciably in reducing the transmission of street noises. As to new theatre projects, it is obvious that the problem of noise reduction is susceptible to more effective treatment.

Interior Noise Sources

Regarding the second of the two classes into which noise sources may be divided, namely, noise which finds its origin within the theatre, it may be said that a large portion of it is a contribution of the audience itself. It is possible to treat in some measure other interior noise sources, but the audience is a factor over which we have but meagre control.

Recent tests conducted in a number of houses indicate that the noise level which may be considered representative of a reasonably quiet audience lies approximately 25 to 30 db. above the threshhold of audibility. Momentary levels considerably in excess of this value may occur and during very dramatic moments much lower noise levels may obtain.

Since audience noise looms largely as a controlling element of the maximum permissible noise level, it is evident that every effort should be made to bring about a reduction in it and in all theatre noise sources. This does not imply that such noise sources will not be heard but rather that their effect on the acoustic conditions of the theatre will have been overcome from a practical standpoint.

Other noises of internal origin include those produced by projection machines, ventilating or air conditioning equipment, house service and other operating units. The noise from these sources may be transmitted directly through the air, or by means of the support or housing of the equipment. The building structure may also serve as the medium for transmitting vibration occasioned by such equipment to distant points in the building where it will be transformed into noise. Correct precautionary measures will serve to minimize both air-borne noises and vibration.

Projection Room Noises

From the viewpoint of the projectionist probably the noise created by projection equipment will be of most immediate interest. As may well be realized, noise problems involving such equipment, that is, projectors, generators, monitors, rewinds and other equipment which forms a part or is accessory to the projection room, have been frequently encountered.

Probably the most conspicuous offender in this respect is the projector itself. The contributing factors are many: worn parts, worn and defective gearing, improper mounting, etc. The method of reducing the noise in the auditorium lies in the selection of quiet equipment or the use of vibration and soundproof projection rooms.

Noise level measurements taken in representative projection rooms indicate a level of from 55 to 65 db. and even these figures may be exceeded in the case of very noisy or worn equipment. Investigation shows that projection room structures must have a reduction of from 45 to 50 db. in order to provide reasonably effective insulation. This is especially the case when the projection room is located immediately adjacent to choice seating areas.

The success of such a sound insulation program entails not only the careful selection of insulative wall material but a meticulous consideration of such apparently minor details as projection and observation ports and doors. This means, of course, that the glazing of projection ports and the type of door construction should as far as possible be equivalent in insulation value to that of the wall structure in which they are used.

Effect of Leakage

As an illustration, let us consider an exposed wall surface of ten feet by ten feet constructed of six inches of clay tile plastered on both sides. Laboratory data establish the fact that such a wall structure would have a mean sound transmission reduction of approximately 44 db. Assuming a total port area of eight square feet glazed with a single thickness of one-quarter inch plate glass, the sound transmission reduction of the structure would be approximately 41.5 db.

However, let us suppose that port and door details have not received proper attention with a resulting loss of one square foot of direct air leakage. In this case the sound transmission reduction for the structure would be approximately 23 db., an obvious loss of 18.5 db. The necessity for strict attention to minor details of construction is immediately apparent.

Extensive investigation into the problem of evolving ways and means for the suppression of projection room noise indicates that the port is one of the most frequently offending members, and the theatre equipment manufacturer would do well to give serious consideration to production of a projection port assembly which would be both acoustically and optically satisfactory.

New Construction Factors

Because of the necessity for meeting the problem of noise reduction, the construction of projection rooms in new theatres and their modification in existing theatres to conform with such requirements involve a number of new factors.

For example, the use of a heavy masonry construction sufficient to provide adequate sound insulation is often precluded by reason of exces-

OUTDOOR NOISES IN NEW YORK CITY		DB ABOVE ZERO NOISE LEVEL	OTHER NOISES
DIST FROM SOURCE IN FEET	SOURCE OR DESCRIPTION OF NOISE		SOURCE OR DESCRIPTION OF NOISE
35	RIVETER	100	SUBWAY — LOCAL STATION WITH EXPRESS PASSING
15-20	ELEVATED ELECTRIC TRAIN	90	
15-75	VERY HEAVY STREET TRAFFIC	80	
		70	
15-75	BUSY STREET TRAFFIC PASSENGER AUTOMOBILES		REPRODUCED SOUND IN THEATRES
		60	PROJECTOR NOISE IN BOOTH
15-300	RATHER QUIET RESIDENTIAL STREET, AFTERNOON		LARGE HALL WITH AUDIENCE TALKING
		50	
15-300	MINIMUM NOISE LEVELS IN ENTIRE CITY DAYTIME 10-20 MINUTE AVERAGE 5 SECOND AVERAGE	40	
15-300	IN MID-CITY NIGHT 5 SECOND AVERAGE		
		30	
			AUDIENCE NOISE DURING PERFORMANCE IN LARGE AUDITORIUM.
		20	MAXIMUM TOTAL NOISE LEVEL FOR OPTIMAL CONDITIONS.
		10	OBTAINABLE IN SOUND PROOFED ROOMS
ABOVE DATA FROM REPORT BY NEW YORK CITY NOISE ABATEMENT COMMISSION			ABOVE DATA OBTAINED BY ELECTRICAL RESEARCH PRODUCTS, INC.

Fig. 3. Sound Levels for Various Sources, New York City

sive weight or prohibitive cost. It has been found, however, that where weight limitations are imposed there is a variety of non-homogeneous constructions which will afford adequate sound insulation and still be satisfactory from a structural standpoint.

It has been established also that under certain conditions special composite sound insulating structures will provide sound insulation equivalent to that afforded by the usual homogeneous masonry construction. The employment of structures of the composite type must, however, be dictated by the contingencies of the specific case for which its use is proposed, and no specific recommendations can be supplied without a precise knowledge of all the factors of the case.

In respect to the problem of isolating vibration which may be created by any part of the projection equipment there are likewise certain fundamental factors which must be given careful thought. As a general rule the procedure consists in the provision of a support which is capable of absorbing or dissipating the vibration energy which is transmitted into it or which will in some other manner function as barrier to the transmission of such energy.

If vibration insulation is to be obtained it is essential that each case be treated individually and correction applied to each vibrating source according to its respective requirements. In general, especially when dealing with the simpler forms of vibration isolation structures, it has been found advisable to have the natural frequency of the mounting when loaded by the vibrating source at least one-fifth of the lowest frequency of the vibration to be eliminated.

Correlation of Elements

That vibration insulation structures will, therefore, have a definite correlation of the elements of mass, stiffness and resistance is immediately obvious. The reduction of vibration transmission to any desired degree may be accomplished by the proper combination of these elements and at the same time it will be possible to meet such other specific requirements which the case may involve. Speaking generally, therefore, the design of an adequate vibration insulation system requires a knowledge of the mass, the distribution of mass, and the frequencies of vibration of the particular unit to be treated and the available floor area and the types of materials which will be most suitable and most effective in the application of corrective measures.

An eminently satisfactory solution of the vibration problem with respect to projection equipment is to be found in the use of large concrete bases which are in turn isolated from the building structure using the usual basic principles of isolation. Such a program is possible only in new theatre construction or in existing theatres where space is available and extensive modifications can be made to the floor structure of the projection room.

It is obvious that the use of a concrete base such as mentioned in the foregoing paragraph gives through its mass added stability and thus minimizes the possibility of flutter of the projected picture on the screen which might otherwise occur through the use of a less heavily loaded elastic support. Inasmuch as the projector is particularly susceptible to shock impact as a result of handling and adjustment during operation, the necessity for such a precautionary measure is immediately apparent.

Applies to All Equipment

Such a corrective program should not be restricted to the projectors alone, but should be applied to all the other units of the projection equipment which are potential sources of vibration. Motor generator sets, for example, are a particularly fruitful source of vibration noises and work and money expended in corrective measures will be repaid amply in quietness of operation.

The elimination of many noise problems common to the theatre can be accomplished through the application of proper precautions in the isolation of such vibration sources. A fact of paramount importance in the institution of such a program, however, is that by itself an isolating material will not make an isolation foundation unless due consideration has been accorded all of the factors involved and a design worked out which will fulfill satisfactorily the particular requirements of the case.

The noise and vibration problems presented in the use of ventilating and air conditioning equipment are similar in their solution to those incurred with the equipment of the projection room. However, there are certain items which will require special treatment. The presence of ventilating ducts essential to such systems, for example, complicates the situation in that they afford a medium for the transmission of noise exterior to the system itself or of noise created within them by the motion of air.

Naturally, a prime requisite of such equipment and one that has been recognized by its manufacturers is silence of operation. However, even the development of equipment which is productive of lower noise levels in respect to its mechanical operation will not eliminate the noise incidental to the passage of air through the ventilating ducts.

An interesting fact in connection with this problem lies in the discovery that if the air velocity within the ducts is maintained below five hundred feet per minute, no unusual noise conditions will be present, and likewise that if the entrance and exit velocity of the air into and from the theatre via these ducts be maintained at substantially lower values, this rushing sound characteristic of air in motion will usually be obviated.

Despite these precautionary measures, however, it has in some instances been found necessary to install acoustic baffles within the ducts as a means of further reducing the propagation of noise. Such baffles, composed of highly efficient acoustic absorbing materials, have proved eminently satisfactory when concentrated at the theatre end of the duct. Caution must naturally be exercised that in these baffles the material is arranged in such a manner as not to restrict the flow of air and that their surface resistance does not detract from the efficiency of the ventilating system.

A point of supreme importance in the installation of the ducts is to take particular care that none of them is rigidly connected to any object which is a potential source of vibration. A material aid in the elimination of noise sources of this type has been found in the use of canvas sleeves and joints at all connections of blowers to ducts.

Medium for Extraneous Noise

A further fact to be noted in connection with the installation of ventilating and air conditioning systems is that it frequently happens that the ducts may be so located as to serve as conductors of noises extraneous to the theatre. Under circumstances such as these it will, of course, be necessary to provide sound insulating constructions around the ducts or relocate them in quieter areas.

In addition to the two major sources of noise which have been discussed somewhat at length in the foregoing, we have those originating in house service equipment, plumbing and heating systems and the like. The correction program will depend more or less upon the nature of the individual case. In the planning of new theatres and in the elimination of noise sources in existing houses the careful location or relocation of plumbing and steam lines merits consideration.

Kliegl Brothers Awarded Radio City Contract

Contracts for complete stage lighting equipment and special lighting devices, for two theatres (Nos. 8 and 10) now under construction in Rockefeller Center, New York, have recently been awarded to Kliegl Bros., Universal Electric Stage Lighting Company, Inc.

Most of the lighting equipment for these more-than-modern structures has been especially designed by Kliegl Bros., for the purpose.

I. A. Convention Makes History and Progress

By BOONE MANCALL

Boone Mancall, Publisher of THE MOTION PICTURE PROJECTIONIST, *Shown With the I. A. Convention Committee at Columbus. Left to Right, Standing: George Lingo, Larry Buck, Harry Coleman. Seated: T. W. Wright, Boone Mancall, Charles Pratt, and Everett James*

AT this writing the Thirty-First Convention of the International Alliance is history. From now it is nothing more than a record on paper. The cold, black type is there for anyone to read. But no one who was not present in Columbus from June 6 to June 11 will ever appreciate the real significance of this convention. It was historic.

How can any one, not present, experience the unhappy, exciting restlessness that surged in the hearts of the convention delegates? How can those who were not in Columbus see before them the drama of that momentous moment when delegates stood up in every corner of the hall shouting to be heard while two men representing two titan locals of the I. A. wrestled in a verbal conflict that surged with passionate emotion and had the beat and rhythm of authentic drama? This was a scene fit for their own medium—the motion picture!

Or feel the soothing hand of a leader capable in a crisis—the hand of President William Elliott, who rose superbly to the occasion and calmed the churning waters of a storm that seemed to threaten the very existence of the International. Or again, to hear the eloquent appeal of Delegate Weir, as he pleaded for justice and reinstatement of two members of his local union who had been expelled by the previous administration.

A Historic Convention

These human elements made the convention historic. In all respects it followed well-set parliamentary routine. Committees were duly appointed, resolutions turned in, committee reports read to and voted upon by the delegates and all other forms of convention business were duly and properly attended to. Official reports of the proceedings are now in the hands of officers and members of the I. A. everywhere and are being given proper consideration. Therefore, this report will concern itself only with the human side.

Delegates began to arrive in Columbus fully a week before the start of the convention. They came from all points in the country and from Canada. They came by automobile, train, boat and plane. By Sunday morning, June 5, all the hotels in the city were filled and many had to resort to accommodation in private homes.

Neil House was the official headquarters of the International officers and here also were the headquarters of the various locals who participated in the entertainment of the visiting delegates from the I. A.'s smaller local unions. The I. A. office was staffed by the usual capable group from the home office and the work of registering the delegates and receiving their credentials was achieved with smoothness and efficiency.

Neil House was the Mecca of all delegates. The lobby of this hotel and all its floors were crowded day and night. Good will and good fellowship were everywhere. Those delegates who were attending their first convention made the best of their opportunity to meet I. A. men from other points and exchange views.

On the Job

AS was done at previous conventions of the International Alliance, a copy of the MOTION PICTURE PROJECTIONIST was in the hands of every delegate in Columbus by the middle of convention week.

The paper was likewise distributed at the convention hall, a copy being placed before each delegate at each morning and afternoon session until the convention adjourned.

In addition there was a display of the paper and all projection books issued by the Mancall Publishing Company in the lobby of convention hall and in the lobby of Neil House, headquarters for the I. A., all through convention week.

The special convention issue was much commented upon and hundreds of constant subscribers came up to the display booth to congratulate the paper's representatives on this number and on the paper's work in general.

The MOTION PICTURE PROJECTIONIST was the only projectionist publication on view and was the journalistic sensation of the Columbus convention.

The New I. A. Slate

WILLIAM C. ELLIOTT, President.

FRED J. DEMPSEY, General Secretary-Treasurer.

JOHN P. NICK, First Vice-President.

WILLIAM P. COVERT, Second Vice-President.

WILLIAM J. HARRER, Third Vice-President.

JOSEPH C. CAMPBELL, Fourth Vice-President.

WILLIAM T. MADIGAN, Fifth Vice-President.

FLOYD M. BILLINGSLEY, Sixth Vice-President.

HARLAND HOLMDEN, Seventh Vice-President.

Hundreds of familiar faces were about and the renewal of old friendships was one of the most pleasant phases of convention week.

The opening day was given over to addresses by distinguished men of the city and state and labor leaders. Chief among these was Rabbi Jacob Tarshis, who, with moving oratory, talked at length on the present economic condition of the country, its causes and effects, its remedies and the place of organized labor in a new economic world which is now being fashioned out of the failure of the old. Rabbi Tarshis' speech was reproduced in pamphlet form as part of the proceedings of the convention and no doubt its study by I. A. members all over the country will evoke the same sympathetic response which it evoked with rousing enthusiasm from the Columbus delegates.

The second day of the convention was given over to reading of the president's and general secretary-treasurer's reports as well as the report of the Board of Trustees and of the Executive Board. The report of the Executive Board was interrupted by Delegate Weir of Minneapolis, Minn., Local 13, who pleaded for the reinstatement of Brothers William Dunn and William Donnelly of the same local. In one of the most able and eloquent speeches ever made from the floor of an I. A. convention, Delegate Weir traced the history of the case, ending with a cry for justice for two men devoted to the cause of organized labor.

Delegate Clyde A. Weston, of East St. Louis, Mo., Local No. 147, defended the action of the Executive Board in this case, asking that no precedent be set which would result in a breakdown of the delegated authority of the Executive Board.

When the question was put before the convention again the whole assembly voted unanimously for reinstatement.

Delegates sat absorbed by the masterly presentation of the case by Brother Weir and his eloquence was one of the high spots of the convention.

The third day was given over to a reading of resolutions and the report of the special committee and most of the new legislation which will guide the International for the next two years was molded and decided upon at this session.

The fourth day will long be remembered by delegates who had the good fortune to be in Columbus. It was but a short interlude in the day's proceedings, but that interlude threatened the welfare of the whole International and in the end created a better International Alliance, more harmonious, closely knit and with a deep respect for the man who has just been elected to guide its destiny for the next two years.

Members of the I. A. will find a brief reference to this episode on page seven of the proceedings of the fourth day. In complete form it appears in the minutes of the convention and is very probably available to any member who cares to take the trouble to study the controversy. But it was charged with all the elements of dramatic conflict and it will make the Thirty-First Convention a milestone in the splendid and colorful history of the International Alliance.

Here was no mere parliamentary question. This was no academic discussion of the privileges and authority of the I. A. office. Nor was it a calm debate over a resolution or a localized grievance. The question itself lay deep in the vitals of the International Organization, affecting every local union of the I. A. in the country. It was bound up with the economic condition of the day and the existence of the smallest and the biggest I. A. local was in the balance.

The air was charged. Every delegate hung breathlessly on impassioned words flung from hearts wrapped up in the welfare of the International Alliance. Dead quiet was in the air, too, as burning words of accusation and self-defense filled the hall. Only the echoes dared intrude.

Then suddenly, as if awakening from a nightmare, the whole convention was in an uproar. Cries for points of order, question on the motion rose up. Emotions, pent-up, surged to the roof.

Let no man question the ability, the common sense, the warm humanness of the President of the International, William Elliott. Big and bulky, a tower of strength in the middle of bedlam, he rose from his seat on the platform and stepped before the microphone. The shouting subsided. The delegates were immediately expectant. They waited.

In a quiet voice that was filled with emotion and which clearly reflected the tension of the moment, President Elliott, without offense, stated that he would refuse to occupy the chair a moment longer if the controversy was to be carried on in such unparliamentary fashion and that if some one did not move for the previous question at once he would leave the chair to do so himself. In few words he cut right to the heart of the problem in a manner so masterly, so simply poised, so self-confident that he won the convention over to his view in a second's time.

The convention then proceeded without interruption. Torn and bruised were the feelings of many delegates but the president had exerted his authority in a crucial moment and had won the delegates over to himself. Afterwards it was said that President Elliott won his reelection in those few moments when his quiet voice subdued the riotous emotions. He too could fight.

Columbus Locals Take Honors

Work of Local Unions Deserves High Praise

Too much praise cannot be given the two Columbus Locals No. 12 and No. 386 for the splendid manner in which preparations for the Thirty-First International Alliance Convention were made and executed. It was chiefly noted that they had cleared away all obstacles and provided for every contingency, thus permitting the convention to occupy the stage and carry on its business without the petty and trifling annoyances which sometimes overtake large assemblies.

The Convention Committee was comprised of three members from each of the two local organizations. Representing Local No. 12 were Messrs. Lawrence Buck, Charles Pratt and George Lingo, and representing Local No. 386 were Messrs. Harry Coleman, Everett James and T. W. Wright.

The handling of the convention—that is from the viewpoint of the Convention Committee—elicited the praise of all the visiting delegates. No one experienced any difficulty in finding quick accommodation after arriving in Columbus. Garage facilities for automobiles had been provided for near the hotels where the delegates were grouped. A certain amount of entertainment, culminating in a dinner for the delegates, was also provided for and it is safe to say that no delegate experienced a moment of boredom away from the convention hall. Everything ran smoothly and at the close of the convention the two Columbus locals received the hearty thanks and appreciation of the whole convention.

Brother Charles Pratt of Local 12 was the chairman of the committee and under his capable hand the arrangements as made beforehand went off on schedule. Brother Pratt was also responsible for exhibition booths in the lobby of the Neil House. Several manufacturers occupied these booths through the convention period and they served as attractions for hundreds of operator delegates.

Brother Buck of Local No. 12 acted as introductory chairman at the opening session of the convention. Under his capable guidance the various speakers were introduced to the convention, until he finally yielded the gavel to President Elliott for the start of the real business.

Not a single member of the arrangements committee but worked tirelessly all through the convention.

Vacuum Tubes for Talking Pictures

By M. J. KELLY *

The vacuum tube has now been in commercial use for almost two decades, during which period it has been the subject of continuous research and development. With the coming of talking pictures, new and even more stringent demands upon it have called for more painstaking and intense investigation of its possibilities and improvement. Mr. Kelly reviews some of these recent vacuum tube and photoelectric cell developments in their relation to talking motion picture systems. The material is reproduced through the courtesy of the S.M.P.E. Journal.—THE EDITOR.

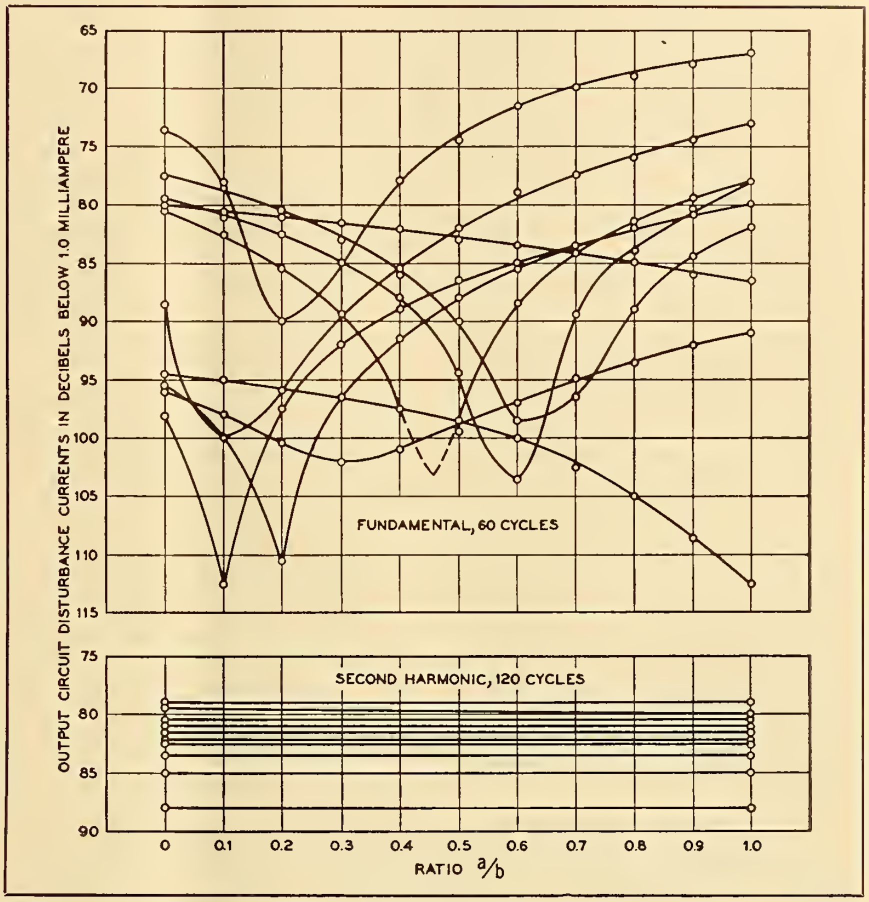


Fig. 2. Disturbance Currents in Typical Indirectly Heated Cathode Triodes

SINCE the standardization of sound recording and reproducing systems many technical developments have been made resulting in less distortion in reproduction, in a decrease of extraneous (background) noise, and in systems having improved operation and maintenance characteristics. The thermionic vacuum tubes used in the recording and reproducing systems and the photoelectric cell used in reproduction are important elements in determining the quality of reproduction, the level of background noise, and the operation and maintenance characteristics of the systems.

A review of the vacuum tube and photoelectric cell developments at the Bell Telephone Laboratories during the past year that have contributed toward such improvements in sound recording and reproducing systems will be given, and the characteristics of the new devices described.

A.C. Tube Requirements

The advantages of obtaining the filament supply of vacuum tubes directly from a.c. lighting circuits have long been recognized. Prior to the time when the indirectly heated cathode vacuum tube became available, much consideration was given to the use of "raw" alternating current for heating the filamentary type of cathode. Due to the magnitude of the 60 and 120 cycle disturbances introduced into the plate current even under the most favorable cathode design conditions, it has not been possible to make at all general the application of alternating current to the heating of filamentary cathodes. In audio frequency amplifiers the 60 and 120 cycle disturbances generally restrict the use of alternating current for heating the filamentary cathodes to the final stage of amplification.

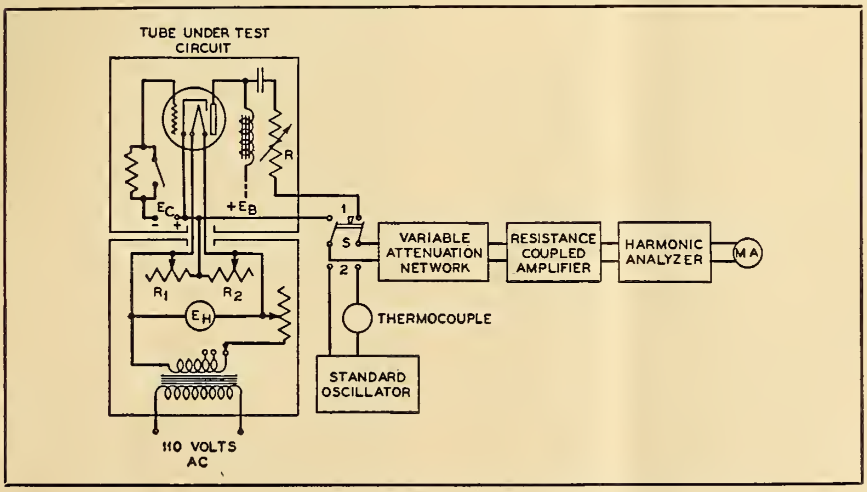


Fig. 1. Circuit Used for Measuring Disturbance Current

The introduction of the indirectly heated cathode into the vacuum triode made immediately possible a further extension of the use of "raw" alternating current as the source of the cathode energy. A heater and cathode unit consisting of a hairpin of tungsten wire imbedded in a cylindrical insulator of magnesia or similar material, with a tightly fitting nickel sleeve surrounding the insulator upon which is deposited the active cathode material, has been generally standardized in triodes for broadcast radio receiver use.

The heater element of such a tube can be lighted by alternating current without introducing 60 and 120 cycle disturbances in radio frequency stages. However, its use in audio frequency circuits having flat frequency characteristics above 60 cycles

---

* Bell Telephone Laboratories, New York, N. Y.

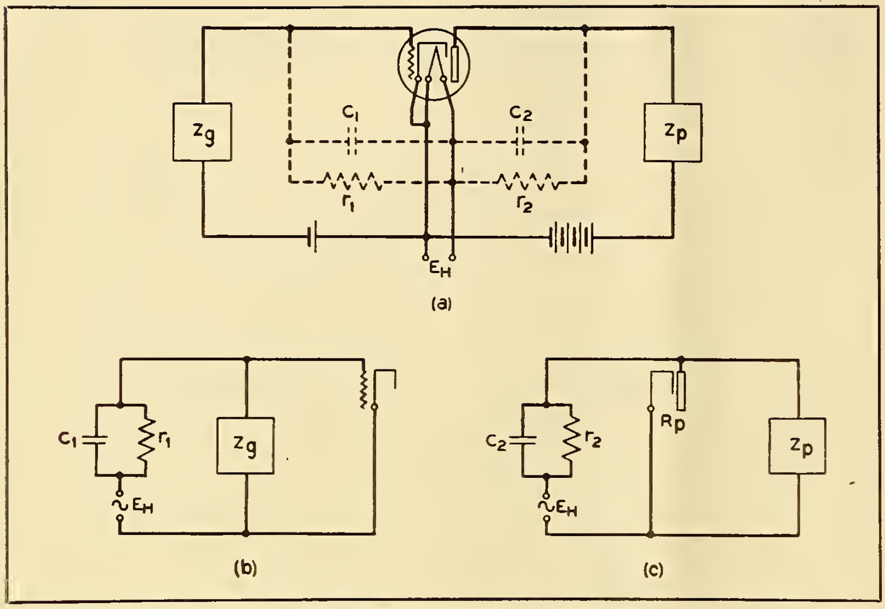


Fig. 3. Equivalent Circuits of Tube, Used for Analyzing Disturbance Current: A, Complete Circuit; B, Input Circuit; C, Output Circuit

is, in general, limited to circuits having gains less than 50 decibels ahead of the first tube heated by alternating current. If such a tube, employing alternating current for the heater supply, is used in amplifiers having flat frequency characteristics and appreciably greater gain, the 60 and 120 cycle disturbances from the heater supply are too great to be tolerated.

A Frequency Limitation

The amplifying units of sound recording and reproducing systems have over-all gains of the order of 100 decibels. In systems having such great gain, it is possible to use alternating current for heating the filaments of all the tubes only by suffering a reduced response at frequencies lower than 120 cycles, or by tolerating in the output a high level of extraneous noise arising from the 60 and 120 cycle disturbances in the tubes of the preceding stages.

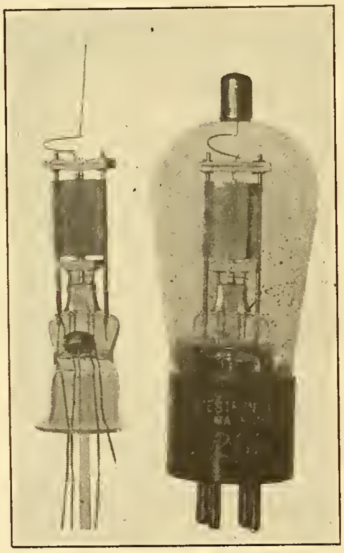


Fig. 4. Type 262A Mounting and Complete Tube

The advantages of using alternating current for the filament supply in high-quality amplifiers used for sound reproduction as well as for public address systems, radio broadcast pick-up systems, and other high-gain audio frequency amplifiers, made desirable the study of 60 and 120 cycle disturbance levels in the plate circuits of the indirectly heated cathode tubes and an investigation of means of making these disturbances sufficiently small to permit the use of alternating current for heating the cathodes of all the tubes in such systems.

In order that alternating current might be generally used for such purposes, the disturbances in the plate circuit of the first tube should not be greater, in order of magnitude, than the resistance and thermionic emission noises. Alternating current could be then used for heating all the cathodes in any amplifier whose gain was not limited by these fundamental causes of noise.

Method of Testing

As the first step in these studies, a measuring system was developed with which one could measure a 60 or 120 cycle current to 120 decibels below a level of 1 milliampere. This system is shown schematically in Fig. 1.

The tube under test is placed in a single-stage amplifier circuit, and its heater supply is so arranged that there is no 60 and 120 cycle disturbance in the plate circuit except that produced by pick-up in the tube itself. The output from this circuit passes through a variable attenuation network to the input of a resistance coupled amplifier. The output of the resistance coupled amplifier is fed into a harmonic analyzer which permits the separation and measurement of the 60 and 120 cycle currents. In order to calibrate the analyzer, an oscillator is provided whose 60 or 120 cycle output can be fed into the variable attenuation network, amplifier, and analyzer.

Two variable 100 ohm resistances of the dial box type are connected in series across the heater terminals of the tube under test. The equipotential cathode is connected to their common point. By keeping the sum of the two resistances equal to 100 ohms, a potentiometer is provided, by means of which the cathode may be maintained at any potential varying from that of one end of the heater to that of the other. It is then possible to determine the value of the disturbance currents as a function of the potential of the cathode with respect to the heater.

Measurements of the disturbance currents in the plate circuits of typical standard indirectly heated cathode triodes were made with the measuring equipment described above. The curves of Fig. 2 exhibit representative results. The levels of the disturbance currents in the output circuit are shown as functions of the position of the common point of the heater and cathode. For a/b equal to 0, the common point is at one end of the heater; for a/b equal to 1, it is at the opposite end of the heater. The measurements were made at the rated plate, grid, and heater voltages of the tube, with an output impedance equal to that of the tube and with an input resistance from 100 to 200 ohms.

The disturbance currents resulting from the a-c. supply used for the heaters of indirectly heated cathode triodes are introduced into the output circuits by the:

(1) Electric field of the heater.
(2) Magnetic field of the heater.
(3) Resistance between heater and grid and between heater and plate, and capacitance between heater and grid and between heater and plate.

The Electric Field

The electric field of the heater element in the space between the cathode and anode will affect the electron current to the plate in precisely the same manner as does the electric field of the control grid. With one point of the heater circuit connected to the cathode, the electric field of the heater at each point in the cathode-anode space will be the sum of the fields due to each segment of the heater element. As the common point of the heater and cathode is shifted along the heater wire, the value of the field will change. It would be expected that, when the common point was located at the mid-point of symmetry of the heater circuit, the electric field would have its minimum value.

The results given in Fig. 2 confirm this expectation for the fundamental disturbance current. A definite minimum is shown in most cases. However, since in the tubes under test the 60 cycle disturbance current is due to factors in addition to the electric field, the expected characteristic variation of the disturbance current due to shift of the common point is masked in varying degrees in the different tubes.

The second harmonic disturbance current does not vary with the position of the common point for the tubes of Fig. 2. From this it might be assumed that there was no second harmonic component due to the electric field. In general, this is not the case. The grid action of the heater circuit varies non-linearly as the effective voltage of the heater system changes with respect to the cathode. This non-linearity of the grid action would be expected to produce second harmonic components in precisely the same manner as they are produced in the familiar case of "mu" modulation with the standard control grid. The second harmonic disturbance current due to the electric field is, in general, very much smaller than that due to the magnetic field, and is masked by it. This is the case with the data of Fig. 2. Experiments have been arranged where the magnetic effects were eliminated and the presence of second harmonic current due to the electric field demonstrated.

Effect of Magnetic Field

The magnetic field of the heater in the space between the anode and the cathode will affect the electron current to the plate. The electrons will be deflected by the magnetic field according to force relations of the magnetic field. The deflection of electrons by this field causes a double frequency change in the electron space charge which results in a second harmonic component of the disturbance current in the anode circuit. Due to asymmetries in the space charge system, the two changes in space charge per cycle of the heater current are not equal. The inequality in the two changes will produce a disturbance current in the plate circuit of the same frequency as that of the heater current.

Heater circuit voltages are introduced into the grid circuit and into the plate circuit through resistance and capacitance between the heater and each of these elements. The circuit diagram shown in Fig. 3 indicates the paths. For simplicity, one side of the heater is shown connected to the cathode, and the resistance and capacitance from the heater to the other elements are connected to the opposite side of the heater.

Experimental tubes of special construction were made in order to evaluate the contribution to the disturbance current of the factors described above. The various means of decreasing the disturbance currents were considered, and experimental models were made in order to check the relative effectiveness of the different means. From these data the best tube, from a manufacturing viewpoint, that would give a sufficiently low level of disturbance current, was designed.

In order to decrease the electric field effect, the heater circuit was electrically shielded. The cathode itself acts as a shield over a portion of the heater circuit. In order to make the shielding more complete, the upper end of the cathode sheath was completely enclosed and the sheath was lengthened so as to extend well below the lower ends of the plate and grid. A drawn metal thimble was then placed around the heater leads below the end of the cathode, extending to the stem press.

The Magnetic Field

In order to reduce the disturbance currents due to the magnetic field, the magnetic field of the heater in the space between the cathode and the anode must be made as small as possible. There are several ways in which this may be done. The heater circuit may be completely enclosed by a sheath of material that will act as a magnetic shield; the heater unit may be so designed that the field outside its surface is substantially zero; or the heater can be made of high resistance so that the heater current is small and its voltage drop is large.

It was found that the most practicable solution lay in combining the last two methods. The heater current was adjusted to 0.32 ampere and the voltage drop to 10 volts. The heater is a closely wound spiral of tungsten wire, mounted in the form of a hairpin in a twin bore magnesia insulator. The geometry of the hairpin is such that the magnetic field in the cathode-anode space is as small as can be realized in a commercial mounting; and the reduction of the

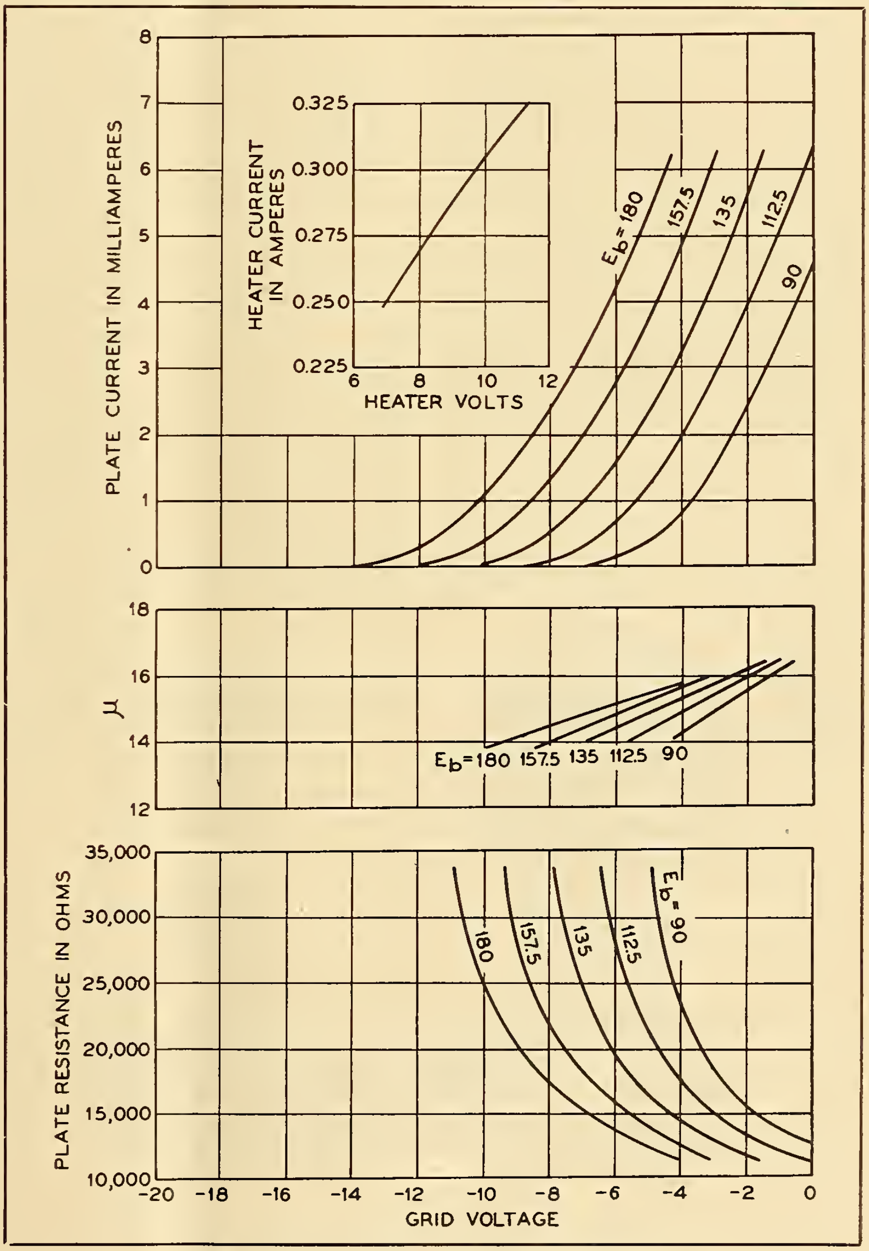


Fig. 5. Electrical Characteristics of 262A Tube

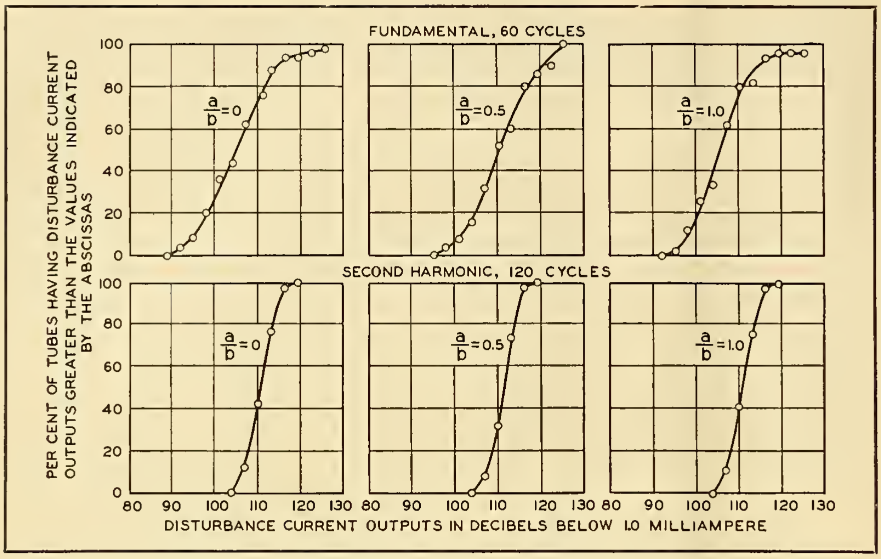


Fig. 6. Distribution of Disturbance Output Currents in a Representative Number of 262A Tubes

heater current to 0.32 ampere, which is approximately one-fifth the value normally used, gives an adequate reduction of disturbance current from the magnetic effect.

By reducing the heater current to this extent the potential drop across the heater is increased from four to five times the value normally used. This increase in voltage increases the electrostatic effect of the heater, increasing the 60 cycle disturbance current. However, it is possible in a commercial structure to shield the structure sufficiently so that even with the increased potential drop the contribution to the disturbance current by the electric field is adequately small.

Resistance Leakage

In order to decrease the disturbance currents due to resistance leakage, the tube elements are held together at the two ends by means of a specially designed insulator. The insulator is so designed that there is not a continuous path between any two of the tube elements on the side of the insulator facing the tube elements. This makes impossible the formation of leakage paths of metal vaporized in the pumping process or of active material vaporized from the cathode. With the tube elements at operating temperature, the leakage between the tube elements, or between the heater and the tube elements, is maintained at a value greater than 100,000 megohms throughout the life of the tube.

For general services the normal values of capacity between heater and grid and between heater and plate, that are obtained with standard mechanical designs, are of sufficiently low value that the disturbance currents introduced through them are not important. However, in such cases as when a tube works directly from the output of a photoelectric cell, it is desirable that the heater-grid capacitance be lower than that obtainable by standard design.

In order to reduce this capacitance to a sufficiently low value, the grid lead for the tube has been brought out at the top of the tube through a cap of the type used in screen grid tubes. No grid supports are placed in the stem press of the tube and all the constructional details of the grid are in keeping with the minimum capacity requirements.

This tube has been standardized by the Western Electric Company and coded 262A. The completed tube and its mount are shown in Fig. 4. Its electrical characteristics are given in Fig. 5. The tube is normally used with a plate potential of 135 volts and a grid bias of —4.5 volts. Under these conditions the plate current is 3.0 milliamperes, the output impedance 15,000 ohms, and the voltage amplification factor is 15. The tube is satisfactory for use with a plate potential of 180 volts and a plate current of 10.0 milliamperes.

Distribution curves of disturbance currents in the output circuits of typical tubes, taken under normal conditions of operation with an input resistance of less than 1,000 ohms, are shown in Fig. 6. These data indicate that for $a/b = 0.5$, the level of fundamental disturbance current for all tubes is less than 95 decibels below 1.0 milliampere, and the level of the second harmonic disturbance current is less than 105 decibels below 1.0 milliampere.

Output Noise Level

The level of the output noise derived from sources other than the a-c. supply used for heating is of interest. The noise level in representative tubes was measured in a voice frequency amplifier that had a flat frequency characteristic. The heater was operated on direct current. With an input resistance of less than 100 ohms, the noise level of the output circuit varied between 118 and 127 decibels below 1.0 milliampere. This noise is principally due to the Schott effect from the cathode. With 2 megohms in the grid circuit the noise level in the output circuit is approximately 105 decibels below 1.0 milliampere. This noise is almost entirely due to the resistance noise of the grid circuit.

It is necessary to have the disturbance currents due to acoustic pick-up or mechanical shock sufficiently low that they will not place a limitation on the fields of application of the tube. The mechanical structure of the tube has been determined with these requirements in view. The tube has a sufficiently low response to acoustic or mechanical stimulus so that, when mounted in a suitably cushioned and shielded socket, the disturbance currents from acoustic and mechanical sources will not be of greater magnitude than the resistance noise and heater current disturbance noise.

When a vacuum tube in an amplifying circuit is subjected to mechanical agitation the resulting motion of the elements of the tube relative to each other gives rise to small transient changes in the electrical characteristics of the tube, which produce transient changes in its plate current. The plate current changes are

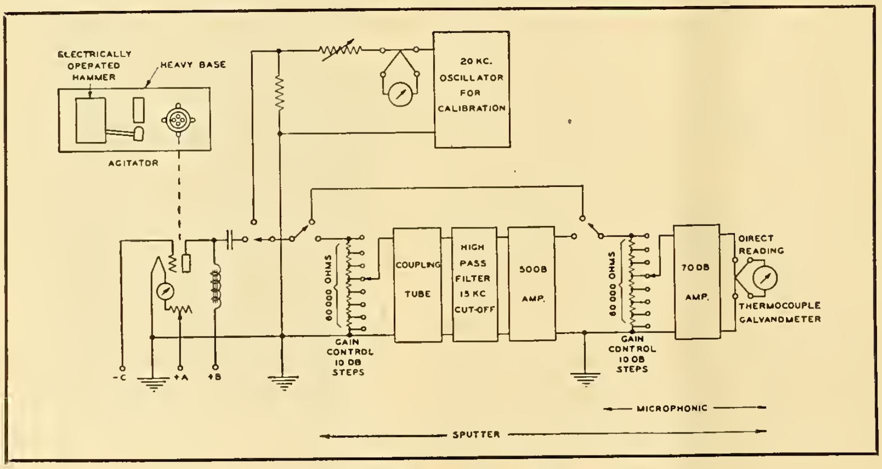


Fig. 7. Circuits for Measuring Agitation Noise

usually of the form of complex damped oscillations, corresponding in their general character to the damped vibration of the tube elements. When these plate current changes are amplified and reproduced by a loud speaker they produce the unpleasant, usually discordant, ringing sound generally designated as microphonic noise.

There is another kind of disturbance whose existence has not been generally recognized, which also arises from mechanical agitation. It is often as much of a limiting factor in noiseless reproduction as is the microphonic noise. It manifests itself in the loud speaker as an irregular scratching or sputtering as contrasted with the more or less sustained ringing sound of the microphonic noise. This sputtering is caused less directly by the relative motion of the elements in the tube, in that it depends on the making and breaking of electrical contacts between metallic parts, which are not otherwise electrically connected, or by the discontinuance change in a relatively high resistance between tube elements.

One of the most common causes of the sputtering noise in the filamentary type of tube lies at the center point of a filament "V," which is ordinarily supported by a small hook attached to a spring imbedded in an insulating support. If this hook is in contact with the filament, its potential will, of course, be the same as the potential of the filament at the point of contact. If, however, it is not in electrical contact with the filament, it will assume some potential, depending upon its degree of insulation from the other elements which, in general, will not be the same as that of the contact point on the filament.

Result of Poor Contact

If the contact between the filament and hook is alternately made and broken, as easily happens when the filament is suspended loosely on the hook and mechanical agitation occurs, the potential of the hook changes discontinuously; and, by a grid-like action, produces corresponding discontinuous changes in the plate current. These plate current changes, when amplified, produce the disturbance designated as the sputtering noise. This type of noise is also due to the imperfect welding of the parts constituting the grid or plate structure. It has also been traced to discontinuous changes in the resistance of thin films of conducting material covering the insulating materials between tube elements.

The level of agitation noise currents in the initial stages of amplifying systems having over-all gains of the order of 100 decibels is sufficiently great to produce an objectionable level of background noise in recording and reproducing systems using such amplifiers.

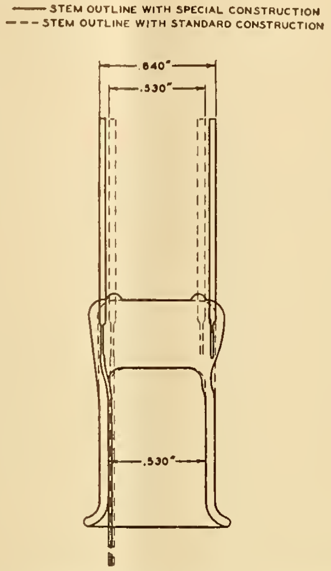

STEM OUTLINE WITH SPECIAL CONSTRUCTION
STEM OUTLINE WITH STANDARD CONSTRUCTION
.640"
.530"
.530"

Fig. 8. Vacuum Tube Stem of 262A Tube

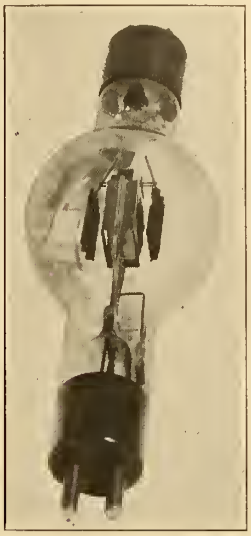


Fig. 9. Rectifier Tube Type 263A

As the first step toward decreasing these agitation noises, a measuring system was developed in which the microphonic and sputtering noise currents could be separated and quantitatively measured when the tube under test was subjected to a reproducible agitation stimulus.

Although the aural demonstration of microphonic and sputtering noises requires nothing more than a high-gain amplifier and loud speaker, the measurement of these quantities presents a number of difficulties. Instead of applying an arbitrary thump with the finger or pencil to the tube under test, it is necessary to provide a constant and reliable agitating agent. If the test is to form a part of a factory acceptance test, the agitation should be continuous, since ballistic readings are slow and unsatisfactory.

The agitation and mounting of the tube should be such that a periodic excitation is applied; otherwise, mechanical resonances may occur between certain tubes in the testing apparatus. Such resonances give rise to misleading results, since a tube with a resonant point at a predominant frequency of excitation will respond much more strongly than other tubes, which on the whole may have very similar microphonic characteristics.

The chief problem in measuring the sputtering noise is not the agitation of the tube under test, although this is important, but rather the separation of the sputtering noise from the microphonic noise.

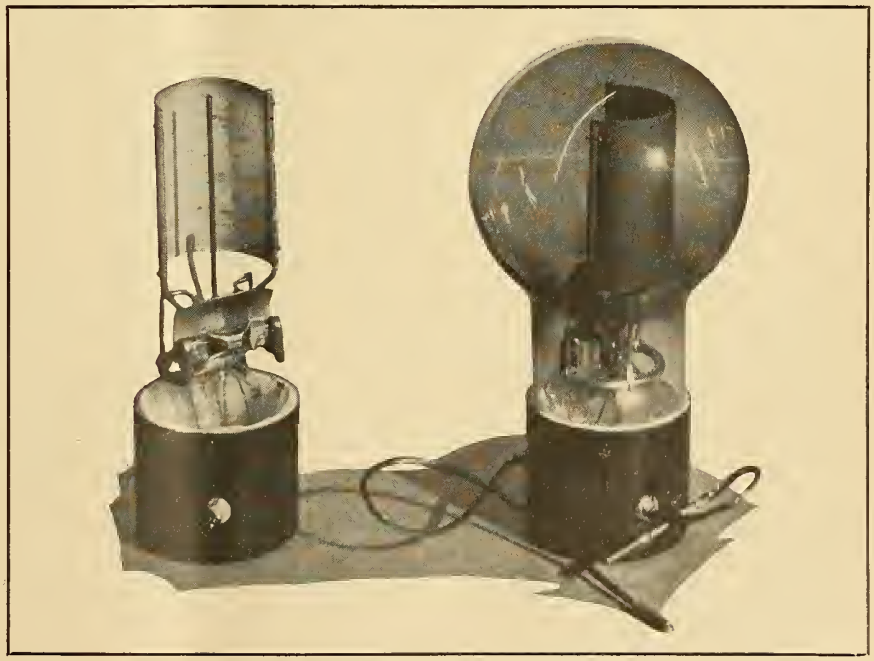


Fig. 10. Photoelectric Cell, Type 3A

Sputtering is often more disagreeable to the ear than microphonic noise, and although the intensity of the noise may sometimes be much higher than the intensity of the microphonic noise, the total energy of the sputtering noise over an interval of time is usually considerably less than that of the microphonic noise for the same interval. This is due to the discontinuous character of the sputtering noise. Since microphonic noise is always present and varies in magnitude from tube to tube and from one operating condition to another, it is practically impossible to measure the sputtering noise by taking differences between measurements of total noise.

Frequency Spectra

Advantage, therefore, has been taken of the fact that a discontinuous impulse may be resolved into a continuous spectrum of frequencies. The frequency spectrum of the sputtering noise extends even into the radio frequency band, and has given trouble in radio frequency amplifiers. The microphonic noise spectrum, on the other hand, lies largely in the audio frequency band, and no components of microphonic noise of measurable intensity have been observed above 15,000 cycles per second.

If a high-pass filter which cuts off below 15,000 cycles is included in an amplifier having a flat frequency characteristic, the microphonic disturbance currents will be effectively suppressed, while the components of the sputtering noise above 15,000 cycles are transmitted with only slight attenuation. The sputtering noise currents of frequencies greater than 15,000 cycles may then be measured by ordinary means.

If it be assumed that the distribution of energy over the entire spectrum is the same for all sputtering noises, then such measurements may be taken as an indication of sputtering noise intensities. While this assumption is certainly not exactly true, it has been found to be approximately so, and the measurements of the components of the sputtering noise at frequencies greater than 15,000 cycles has proved of much value in conducting investigations of tube noises.

On the basis of these considerations, a measuring system was developed which comprised four essential parts: a tube mounting and agitating system, a flat-frequency amplifier, a high-pass filter, and an indicator. These units are arranged as shown in the schematic diagram of Fig. 7.

Details of Agitator

The agitator consists of a thick slate base on which is rigidly mounted at one end an uncushioned tube socket, and at the other end a vibrating hammer which directs horizontal blows against a steel block firmly mounted on the base near its center of gravity. The hammer consists of a good vibrating electric bell, the gong of which has been replaced by the steel block just mentioned and whose clapper has been weighted by the steel hammer. This hammer strikes eight times per second; and because of the rigidity of the base mounting, for all practical purposes, it causes shock excitation of the tube under test. The frequency of the blows is so low that there is little likelihood of encountering resonance in tubes under test.

The tube under test is mounted in the socket of the agitator, and is operated under its standard plate, grid, and filament voltages, with a resistance of 60,000 ohms in the plate circuit. By means of taps brought out from this resistance the input to a coupling tube is controlled. A high-pass filter with a cut-off at 15,000 cycles follows the coupling tube. The filter is followed by a two-stage, 50 decibel amplifier, a gain control unit, and, finally, a two-stage, 70 decibel amplifier. The output of this amplifier is measured by means of a suitable thermocouple galvanometer. The amplifying system has substantially a flat frequency characteristic over a range from 50 to 30,000 cycles. It is down 3 decibels at 30,000 cycles and 2 decibels at 100 cycles, and is calibrated by means of a 20,000 cycle oscillator.

When the total agitation noise of the tube is measured, the 50 decibel amplifier, the high-pass filter, and the coupling tube are not included in the circuit, the output of the tube under test working directly into the 70 decibel amplifier. For separately examining the discontinuous noise, which has been designated as sputtering noise, the 50 decibel amplifier, the high-pass filter, and the coupling tube are inserted. A measurement is then made of the components of the sputtering noise having frequencies greater than 15,000 cycles. The variable potential drop produced across a fixed resistance of 1,000 ohms in the output circuit of the tube by the standard agitator is taken as a measure of the microphonic noise level of the tube. This potential drop is expressed in terms of decibels below 1.0 volt.

Measuring System Helpful

This measuring system has been of great value in studying the agitation noise levels during the development of sufficiently quiet tubes for high-gain amplifiers. It has also been of service in making comparisons of the cushioning action of different types of tube sockets and mountings. For this purpose the agitation noise characteristics of a group of tubes of a given type are determined with the rigid mounting described above. The noise characteristics of the same tubes are again determined with the tube mounted in the socket under examination, or, if cushioning material is under investigation, with the cushioning material inserted between the agitator slate base and the socket. A comparison of the two sets of readings gives a measure of the effectiveness of the cushioning material.

A set of this type has been found satisfactory for use in acceptance tests for agitation noise in vacuum tubes. The manufacturing department's sets are kept in calibration with respect to a master set in the laboratory by means of a group of reference tubes.

The detailed mechanical design of the low hum level tube, the 262A, described previously, has been based on agitation noise level studies made in this system. Both its microphonic and sputtering noise levels are sufficiently low that with standard cushioning and shielding, the agitation noise currents in its plate circuit, when used as the first tube of a 100 decibel amplifier, will be no greater than that of the emission noise currents.

There are many applications in which a cathode that consumes less energy than that of the indirectly heated cathode of the 262A tube is desirable. A tube having such a filamentary cathode has been developed for those services demanding microphonic noise levels much lower than those of tubes previously standardized for such systems.

Used in Preliminary Stages

In Western Electric systems the 239A tube has been used in the past for preliminary stages of high-gain amplifiers. The new filamentary cathode tube, which has been coded 264A, has been made identical with the 239A in mechanical dimensions and in electrical characteristics, except for a slight change in the filament characteristics. With a plate potential of 100 volts and a grid potention of —8 volts, its average output impedance is 12,500 ohms. The average amplification factor is 7, and the average plate current is 2.0 milliamperes. The filament current is 0.30 ampere and the nominal filament potential drop is 1.5 volts.

The microphonic noise level of a 239A tube measured in the equipment described above has an average level of 28 decibels below 1.0 volt. The corresponding value for the 264A tube is 45 decibels below 1.0 volt, while it is 50 decibels below 1.0 volt for the 262A tube. It is again pointed out that these measurements were made in uncushioned sockets, and with direct transmission of mechanical disturbance from a relatively high level source. Significance should, therefore, be attached only to the relative values of noise levels and not to absolute values.

The sputtering noise level of the 239A tube under the same conditions of measurement has an average value of 80 decibels below 1.0 volts, while the 264A tube has an average value

(*Continued on page* 32)

The Fundamentals of Sound

By LEDWARD EVERETT

The treatise continues with a discussion of the effect of sound waves upon each other and considers also the natural vibratory period of objects, particularly in respect to sound recording and reproducing equipment, and the possible influence of the phenomenon upon the quality and the fidelity of the reproduced sound if not given proper thought in equipment design. The installment concludes with a consideration of speech and the complex wave forms which it involves.—THE EDITOR.

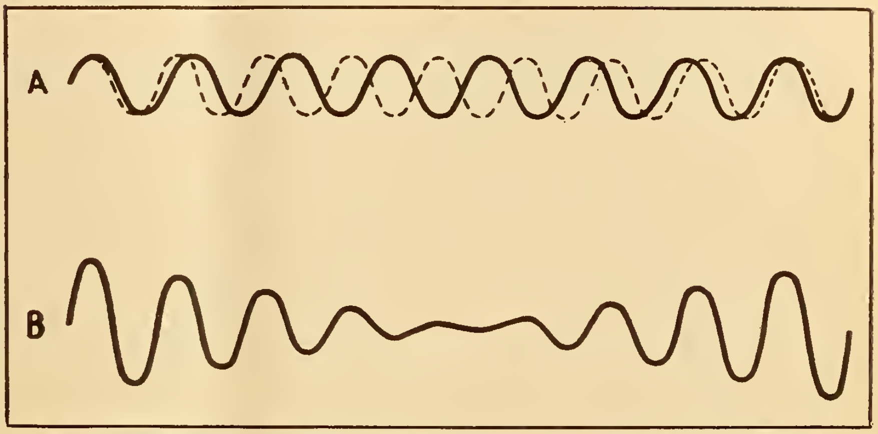


Fig. 19. *Effect of Interaction of Two Waves of Different Frequencies*

Part V.

IN our previous installment it was shown that it is possible for two sound waves of similar frequency characteristics to unite in such a manner as to reinforce each other. It is also possible for two sound waves of similar characteristics but one hundred and eighty degrees out of phase to nullify each other.

This nullifying effect is quite common in certain untreated or acoustically poor theatre auditoriums where a survey of the house will show that because of wall reflection or other causes focal points are produced resulting in so-called dead spots. It is for this reason also that when more than one stage speaker is used it is necessary to see that the speakers are in proper phase relationship, that is, that the cones or diaphragms move in the same direction at the same time.

Beat Notes

Two sounds of different frequency produce an effect which is known as "beats." For example, if two tuning forks of similar characteristics are used and one of them is weighted slightly so as to effect a slight change in its frequency (this weighting may be accomplished by attaching a small object such as a coin to one of the prongs of one fork), when the forks are struck a pulsing or throbbing sound will be heard. This is due to the fact that at one instant the two sound waves are reinforcing each other and at another instant there is a nullifying effect.

This may be more clearly understood by referring to Fig. 19, in which it is assumed that one of the forks is vibrating at a frequency of 256 cycles represented by the dotted line, while the other has been retarded to 255 cycles as indicated by the heavy line.

If, at the beginning of a given second, the forks are vibrating in unison so that they are sending out simultaneously areas of compression and areas of rarefaction they will unite so as to produce a double effect of loudness upon the ear. Since one of the forks will gain one complete vibration or cycle per second over the other, at the end of the second under consideration the forks will again be vibrating in unison. However, in the middle of this second the two forks will be vibrating in opposite directions, so that there is an opposing effect in areas of compression and rarefaction being emitted by the forks.

The result is that there is a tendency to stop the to and fro motion of the particles of air that convey the sound wave to the ear. This nullifying effect of one wave upon the other is shown in wave B of Fig. 19, where the two opposing waves in the middle of A produce the nullification of wave motion shown in the middle of wave B.

Effect of Natural Period

The effect of the natural vibratory period which, as has been previously explained, every body possesses, must be given careful consideration in sound work. The phenomenon may be particularly troublesome in the case of a disc reproducer or reproducer arm which because of poor design has a natural period within the audio frequency range. The result will be that the response of the mechanism when reproducing a frequency corresponding to the natural period of the mechanism will be abnormal.

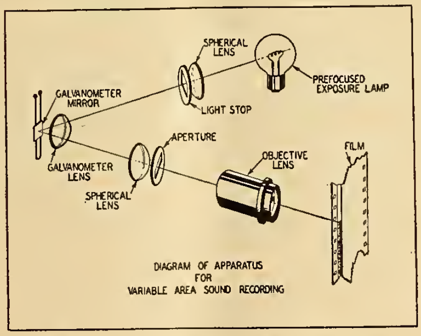


Fig. 20. *Variable Area Recorder*

The effect may also be easily demonstrated in the case of certain parts of sound recording equipment. The remedy is to keep the natural period of such mechanism outside of the audio frequency range. For example, at the left of Fig. 20 is shown the galvanometer oscillograph as employed in the RCA Photophone recorder. The mechanism consists of a tightly stretched loop of wire upon which is cemented a tiny mirror. Naturally, this schematic view is greatly enlarged, the mirror actually being approximately the size of a pin head.

The action is such that when the current through the loop is in one direction the loop twists one way, and when the current is in the other direction the loop twists in the opposite way. The sound currents from the recording amplifier are alternating in form and of the same frequency as the sound being recorded so that the result is that the mirror vibrates at the same frequency and in proportion to the magnitude of the sound wave as picked up by the recording microphone.

Varies With Tension

The natural vibratory period of the loop varies with the tension which is applied, the greater the tension the higher the frequency of the natural period. It is necessary therefore to apply such tension that the natural vibratory period of the loop will be considerably above the highest frequency that is to be recorded. As the recorder usually operates over a band of from about 30 to 6,000 cycles, the loop is so adjusted that its natural period lies beyond this latter figure.

Let us assume for the purpose of demonstration that the tension of the loop has been lessened to a point within the recording range—say two thousand cycles. If such were the case, every time a two thousand cycle note is recorded, causing the loop to vibrate at this frequency, the loop will swing more freely, due to the fact that it is its natural period of vibration, and the result will be that the record photographed on the sound track will produce more relative volume when reproduced than that of other sound frequencies of the same amplitude.

The same phenomenon applies to many other units of the sound recording and reproducing system. The effect is often very noticeable in poorly designed loudspeakers.

The Nature of Speech

Early in this series of articles it was explained that vocal sounds are produced when air from the lungs is forced past the vocal cords, causing them to vibrate, thus generating sound waves which pass out through the mouth into the air. Through the action of the tongue, the shaping of the oral cavity and the vocal passages, these sounds are modulated to produce speech. Sounds produced through the aid of the vocal cords are known as vowels. Certain sounds, however, are produced without the aid of the vocal cords, that is, by forcing the air from the lungs through the pursed lips or over the edges of the teeth. Such sounds are known as consonants.

Speech, therefore, is composed of combination of vowel sounds and consonants so constituted as to form words. Speech is comprised of the fundamental frequency of the sound and one or more overtones or harmonics. These overtones impart the identifying characteristics to the sound.

This is demonstrated in a rather interesting manner by the curves shown in Fig. 21, which consist of several oscillograms or sound wave recordings of various spoken words. The frequency scale is indicated at the bottom of the illustration and by noting where the hills and valleys occur in the curve, the frequencies of the various overtones can be determined.

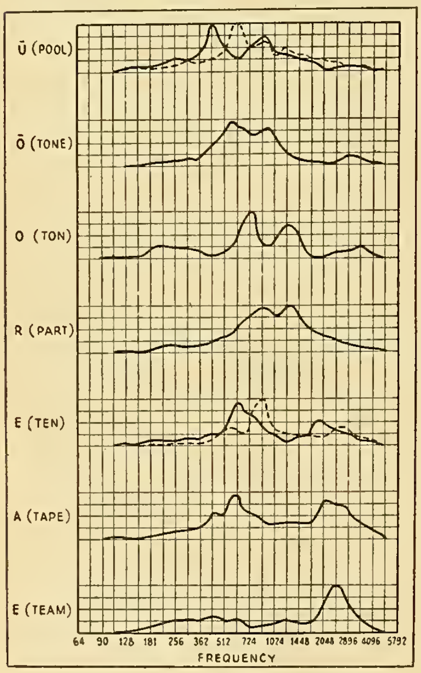


Fig. 21. Word Oscillograms

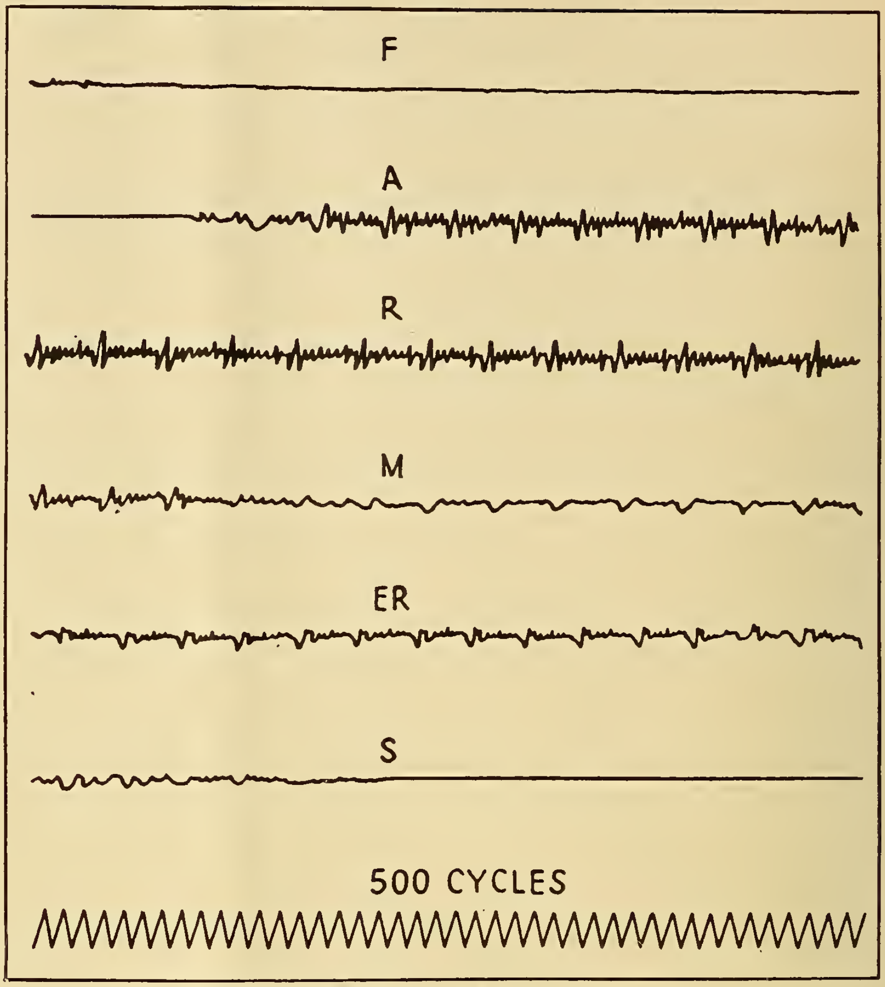


Fig. 22. Oscillogram of the Word "Farmers"

Examining the curve for the sound *u* as used in the word "pool," it is possible to say the word in a low or a high pitched voice and it will still be recognizable even though the frequency has been raised or lowered. No matter what the frequency of the fundamental is, however, it is essential that there be an overtone of unusual prominence between 400 and 600 cycles if the word is to retain its identity. A female voice speaking the same word is shown by the dotted line in the same figure. It is evident the frequency is higher than that of the male voice.

The vowel *a* as used in the word "tape," as is evident from the drawing, has two prominent overtones. One of these lies in the neighborhood of 600 cycles and the other at approximately 2,400 cycles.

As is apparent from inspection of this set of curves, every sound has a characteristic form which applies to that particular sound only, and should the form be materially changed, the speech sound would not be recognizable as the same vowel or word.

An interesting example of the manner in which a word is composed of sound waves of varying frequency and amplitude is shown in Fig. 22. The word "farmers" is used for the demonstration. For purposes of comparison, the record of a 500 cycle note is shown at the bottom of the illustration.

(*To be continued*)

National Slide Company Reports Satisfactory Progress

The National Slide Company of New York, manufacturer of all types of slides for use in connection with special effects, organ solos, etc., announces that business for the past month has been eminently satisfactory. The recent political conventions and the coming national election are given as the principal reasons for the active interest in the Rapid-Type slide, one of the company's most popular products.

The slide is constructed in such a manner that the blank may be inserted in a typewriter, typed and immediately mounted for projection to the screen. These features make the device particularly desirable where instantaneous announcements are to be made.

A Portable Reflector Arc Lamp*

By HARRY H. STRONG †

The author describes a portable arc lamp of the reflector type and a full wave rectifier designed especially for use with the lamp in the case of a-c. supply. The lamp is compact and particularly adapted for employment with portable projectors. The equipment is of an efficiency sufficient to furnish ample screen illumination with current from a 110 volt lamp socket.—THE EDITOR.

A NEW field for motion picture projection has been created by the perfecting of portable sound equipment. This type of equipment is finding extensive application for educational and advertising purposes, as well as for entertainment in small theaters and in auditoriums of moderate size.

In all of these uses, however, the audience is composed of individuals accustomed to the large projected image and brilliant screen illumination characteristic of the motion picture theater today. They are no longer satisfied with a picture three or four feet wide, a low intensity of screen illumination, and sound coming from a position at one side of the picture.

Light Required

The attainment of satisfactory results in the use of portable sound equipment requires a picture eight to twelve feet wide, a porous screen permitting the sound to come from the screen itself, and a light source of sufficient power to afford a screen illumination and brilliancy comparable with that seen in the popular theaters.

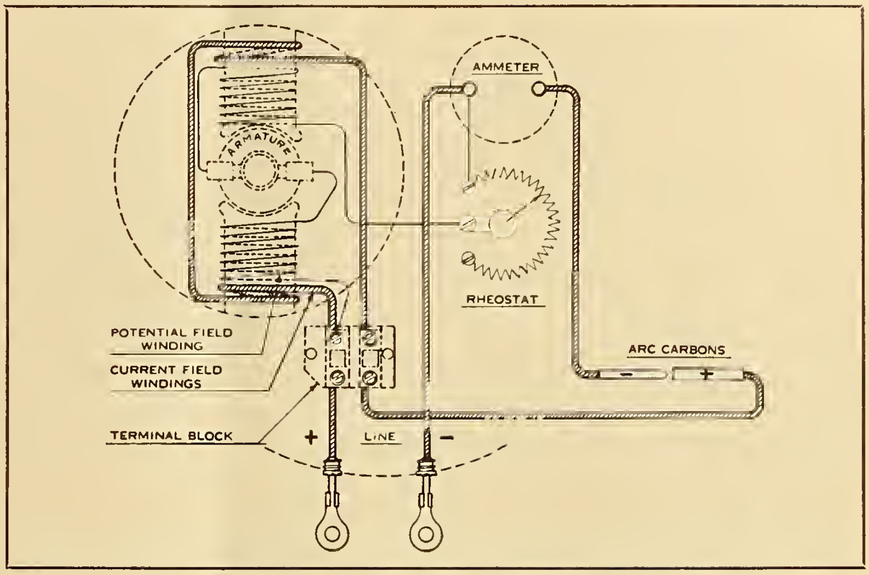


Fig. 1. Wiring Diagram of Arc Control System

The d-c. carbon arc is the only available source of light possessing sufficient power and concentration to satisfy the requirements of this newly created condition. Adaptation of the d-c. carbon arc to portable equipment, however, presents certain problems, the solution of which has required careful study and extensive experimentation.

Portability places definite restrictions on the weight and bulk of equipment, and these factors must be given careful consideration in working out details of design. Direct current is no longer available in most localities, except in central urban districts. This condition makes it necessary to provide some means of converting the alternating current of the power supply to direct current suitable for use at the arc.

Simplicity of operation is a requisite of prime importance in portable equipment, since the equipment is more likely to be used by an operator of little experience than by one having extensive knowledge of motion picture equipment. Finally, results must be attained in a manner to afford efficient use of electrical power so that connections may be made to any available light socket.

A Portable Arc Lamp

It is the purpose of this paper to describe a portable, reflector type, carbon arc lamp and rectifier, developed

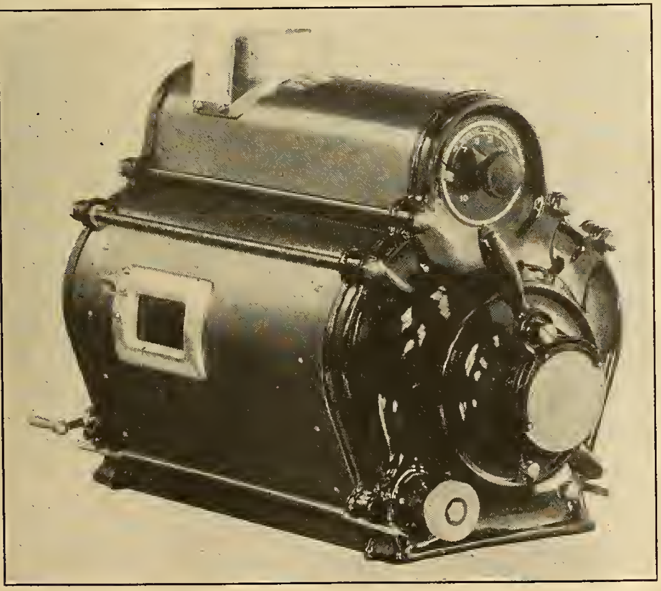


Fig. 2. Lamp Showing Focusing Adjustment Knob and Motor Control Rheostat

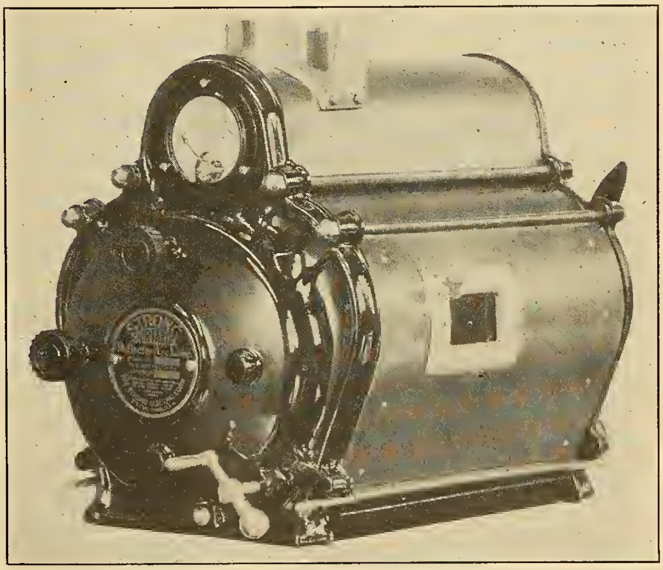


Fig. 3. Lamp Showing Ammeter, Arc Imager and Manual Controls for Mirror and Carbons

to meet the difficult conditions outlined in the preceding paragraphs.

---

* Courtesy of the S. M. P. E. Journal.

† Strong Electric Co., Toledo, O.

The remarkable success of the reflector type of arc lamp in standard theater projection has led to the adoption of the reflector principle in the development of the portable unit. The superiority of d-c. reflector arcs is due basically to the interception of a large angle of radiated light emanating from the crater of the positive carbon and the reflection of this light, as a converging beam, to the film aperture. The adaptation of these principles has resulted in the development of a compact unit only 18 inches long, 12 inches high, and 10 inches wide, well proportioned and having exceptional power.

The urgency of reliable performance in the hands of the lay operator requires the elimination of hand control of the arc. This is accomplished by means of a fully enclosed control motor, which is mounted as an integral part of the lamp house, and which automatically feeds the carbons at exactly the same rate at which they are consumed, thus maintaining the proper arc length throughout the entire burning of the carbons.

The automatic arc control system operates upon the principle that certain electrical characteristics of an arc are changed as the carbons are consumed. Use is made of these changes to control directly the speed and direction of rotation of a differentially compounded motor. A wiring diagram of this motor is shown in Fig. 1.

Control Motor Details

The armature of the control motor is geared to the carbon carriages in such a manner that the rotation of the armature will cause the carbons to move closer together, or farther apart, depending upon the direction of rotation of the armature. Since the armature is so connected that it is electrically energized at all times, its speed and direction of rotation, and hence the movement of the carbon carriages, will depend upon the direction and strength of the magnetic field passing through the armature.

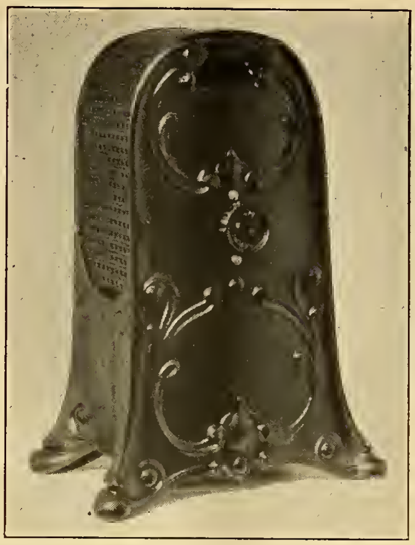


Fig. 5. Exterior View of Full-Wave Rectifier

The field of the motor consists of two windings which are differentially connected—a shunt or potential winding, and a series or current winding. The shunt winding, comprising many turns of fine wire, is connected through a rheostat across the arc. This sets up a magnetic field which tends to rotate the armature in a direction that feeds the carbons toward each other. The series winding, comprising a few turns of heavy wire, is connected in series with the arc, and sets up a magnetic field opposed to that of the shunt winding, thus causing the armature to rotate in a direction that separates the carbons.

When the arc is burning properly, and the rheostat which controls the strength of the shunt winding is adjusted so that both the series and shunt windings are of equal strength, the two field windings neutralize each other and the armature does not rotate. As the arc gap increases, due to the normal burning of the carbons, the potential across the arc is increased and the current through the arc decreased. An unbalanced condition is thus created in the field windings, and the resultant magnetic flux through the armature is equal to the difference in strength between the shunt and series field windings. Under these conditions the armature will rotate in a direction to bring the carbons closer together and compensate for the burning loss.

The rheostat, in series with the potential field windings, permits adjustment of the strength of the potential field in relation to that of the series field, so that proper motor speed may be established and the proper arc length maintained for any given operating current. The rheostat is provided with an adjusting knob and indicating dial at the top of the lamp house, as shown in Fig. 2.

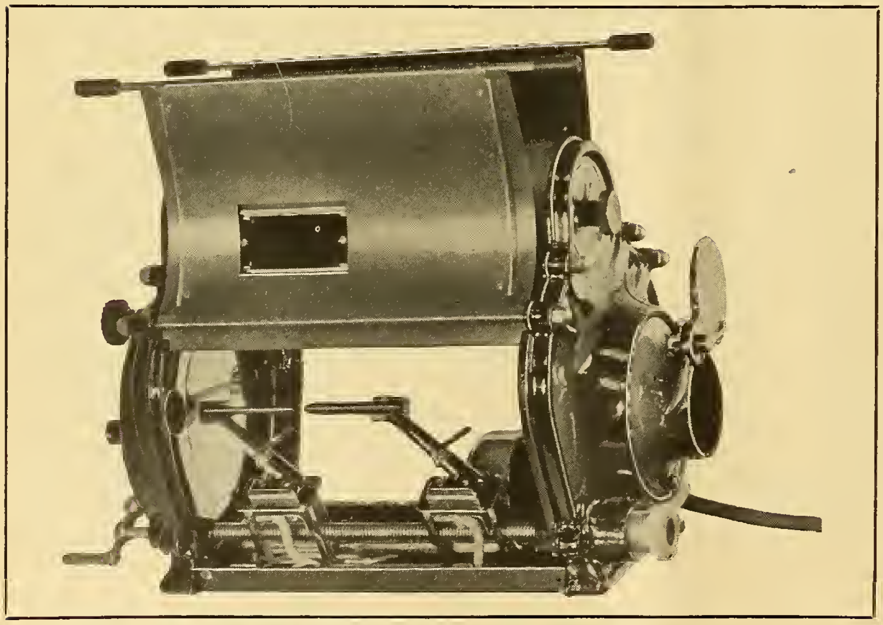


Fig. 4. Interior View of Portable Arc Lamp

Control Entirely Automatic

The operation of the arc control is entirely automatic and continuous. Once the arc has been struck and the carbons separated to the proper arc length, the control motor rotates slowly and continuously, feeding the carbons toward each other at a rate that exactly equals their consumption. A uniform arc gap is thus maintained without manual control.

An arc imager is mounted on the side door of the lamp house adjacent to the window. The imager projects an image of the arc and the incandescent carbon tips to a small screen secured to the side of the vent stack. This device can be seen in Fig. 3. While the lamp is in operation, the lines on the imager screen will indicate the proper position of the positive crater in its relation to the focus of the reflector, as well as the correct position of the negative carbon in relation to the positive.

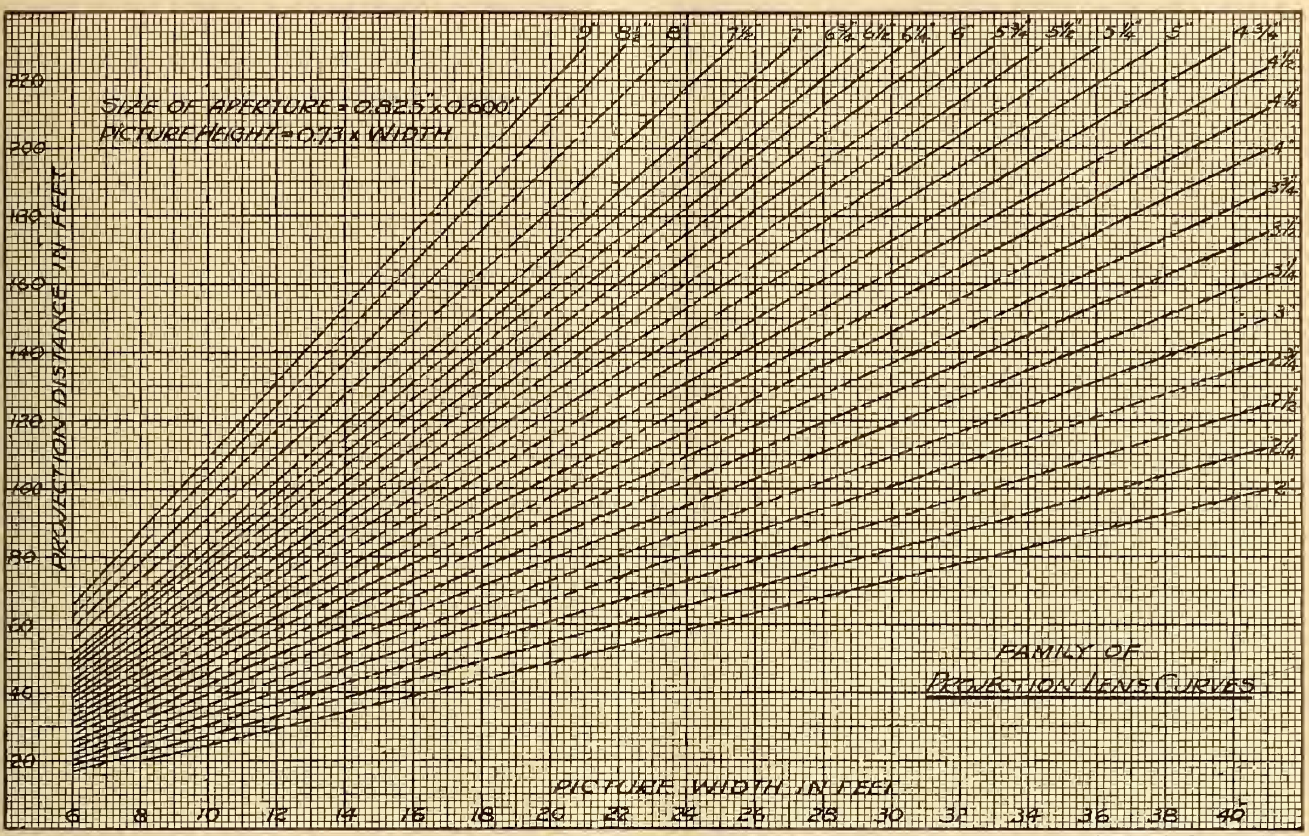
The operator may adjust the position of the positive crater to the exact focus of the mirror by turning the knurled knob at the lower lefthand corner of the lamp house, as shown in Fig. 2.

"Striking the arc" is accomplished by turning the ball crank at the rear of the lamp house. This crank is clearly shown in Fig. 3. The ball crank further permits manual adjustment of the arc length, *i. e.*, adjustment of the negative carbon in relation to the positive. Once this relation has been set, the carbons seldom require further manual adjustment. The automatic control, under normal conditions, will maintain the proper arc length and position of the positive crater for the entire burning period of one complete trim.

(*Continued on page* 28)

Theory and Fundamentals

By W. W. JONES



© W. W. Jones, 1932

Family of Lens Curves for New Standard Aperture

Mr. W. W. Jones, whose Department is a monthly feature of this magazine, has long been actively associated with the Motion Picture Industry. At the present time Mr. Jones is a member of the Photophone Division of the RCA Victor Company. He is a graduate of the Milwaukee College of Engineering and was at one time Instructor of Mathematics and Electrical Design at that Institution.—THE EDITOR.

The New Standard Aperture

Now that the Academy of Motion Picture Arts and Science has adopted a standard for motion picture camera and projector aperture sizes, we may look forward to seeing on the screen a picture having uniform relative dimensions of approximately 3 to 4. In order to aid the projectionist in the selection of lenses of the proper focal length, and to aid him in the proper masking of his screen for the new standard aperture the author has prepared the accompanying chart which represents a family of projection lens curves based on the new aperture dimensions.

Each line in the family of lens curves represents a particular lens size. There is a curve for each commercial lens size from an equivalent focal length of 2 inches to 7 inches in one quarter inch steps and from 7 inches to 9 inches in one half inch steps. The curves may be used for projection distances up to 240 feet, and for picture widths up to 42 feet.

The curves when properly used serve a threefold purpose. They may be used (1) to determine the picture width for a given lens size and given projection distance, (2) to determine the proper lens size for a given picture width and a given projection distance, and (3) to determine the projection distance for a given picture width and a given lens size.

Use of Curves

The following will serve as an example in the use of the curves. Let it be desired to find the picture width when the new standard aperture is used for a projection distance of 110 feet and a 5 inch E.F. lens. Referring to the family of curves select the line marked 5 inches at the end of the line. Next, find the projection distance of 110 feet on the vertical axis of the curve, and draw an imaginary horizontal line across the page. Then from the point where the imaginary line intersects the 5 inch lens line draw a vertical line downward to the horizontal axis of the curves. The picture width then will be the value read from the horizontal axis where the vertical line intersects the axis, which in this case is found to be 18 feet.

To Determine Lens Size

Now let it be required to find the proper lens size for a picture width of 20 feet and a projection distance of 90 feet. Draw a horizontal line from the projection distance of 90 feet, and draw a vertical line from the picture width of 20 feet. Then, select the lens size indicated on the line nearest the intersection of the vertical and horizontal lines drawn. In this case the lens size is three and three quarter inches E.F.

Since the aperture dimensions are fixed the relative dimensions of the picture on the screen will be the same as for the aperture provided a zero projection angle is used. It is to be noted that the ratio of height to width for the new picture aperture (0.600 x 0.825) is 0.728 or approximately 0.73. This ratio of aperture size can be used to determine the picture height for any given width at zero projection angle by merely multiplying the picture width by the ratio 0.73.

(*Continued on page* 30)

Shaft to Captain Lomb Unveiled

Impressive Services Held at Rochester, N. Y.

A SHAFT of black Minnesota granite, of simple but imposing design, erected in the triangular park at the eastern end of the new Bausch Bridge at Rochester, N. Y., was dedicated amid an impressive Memorial Day ceremony to the patriotic, philanthropic and civic services of Captain Henry Lomb, co-founder of the world-famous optical concern of Bausch and Lomb.

German by birth, Mr. Lomb came to America in 1849 at the age of twenty-one years. He went to Rochester and in 1853 joined with J. J. Bausch in the little optical shop which the latter had established in the Reynold's Arcade that city. The early history of the little optical concern was a hard struggle. It is said that Mr. Lomb often canvassed the surrounding countryside with his optical wares, selling some of the first eyeglasses that some of his customers had ever seen.

Mr. Lomb's patriotism and love for his adopted country early evinced itself. At the outbreak of the Civil War, on April 23, 1861, he enlisted in the Thirteenth Regiment of the New York State Volunteers, which was afterwards known as the "Fighting Thirteenth." He was active in the organization of Company C, composed largely of Germans, among whom he was so well liked that he was elected their First Sergeant. Later he was promoted to First Lieutenant, and finally to Captain.

Captain Lomb remained with the Thirteenth Regiment during the whole term of his enlistment. In that time he and the "Fighting Thirteenth" saw action in more than twenty important engagements, including such well-known battles as the first and second Bull Run, Fairfax Court House, Antietam and Fredericksburg. He returned to Rochester with the remnant of his regiment and mustered out on May 13, 1865.

In the meantime, Mr. Bausch had managed to keep their optical business alive, though general conditions made that task even harder than it had been before. In fact, it is said that more than once Captain Lomb's pay, sent back from the fighting zones, saved the day. Now Captain Lomb himself could resume activity in the enterprise, and over a period of years saw it grow to success.

The Bausch & Lomb Optical Company soon became large enough to demand a sales department in New York City. Henry Lomb moved to New York to take charge of this new office. Except for the years he was there he remained a resident of Rochester until his death.

Philanthropic Activities

Captain Lomb founded and developed some of the most useful public enterprises of Rochester. The Mechanics Institute of that city stands as a monument to his great interest in the working man, and his efforts to equip him for life and work. The Rochester Public Health Association for which he was responsible also was devoted largely to this end. To it were attached a free dispensary and clinic and the first local dental dispensary, which later was to grow to world-wide proportions in Mr. George Eastman's philanthropic hands. Captain Lomb gave to these public works not only his time and organizing genius, but many times supported them entirely or in part from his own personal funds. Kindergartens in public schools and the formation of the German-American Society for assisting German immigrants to become oriented to their new home brought Henry Lomb the gratitude of thousands of Rochesterians.

On June 13, 1908, Captain Henry Lomb died. Leading members of the community insisted upon public funeral services, which were carried out at Convention Hall, and participated in by all classes of citizens. He is survived by his widow, the former Miss Emilie Klein, whom he married in 1865, and two sons, Adolph and Henry Charles.

The imposing black shaft of the Lomb Memorial Monument commands the approach to the Bausch Memorial Bridge, which was dedicated by the people of Rochester to the memory of Captain Henry Lomb's partner, John J. Bausch. Traveling east over the Bausch Memorial Bridge one sees the Lomb Memorial rearing its beauty and simple dignity against the sky, and to the left the great factories of the Bausch & Lomb Optical Co., of which Henry Lomb was a co-founder.

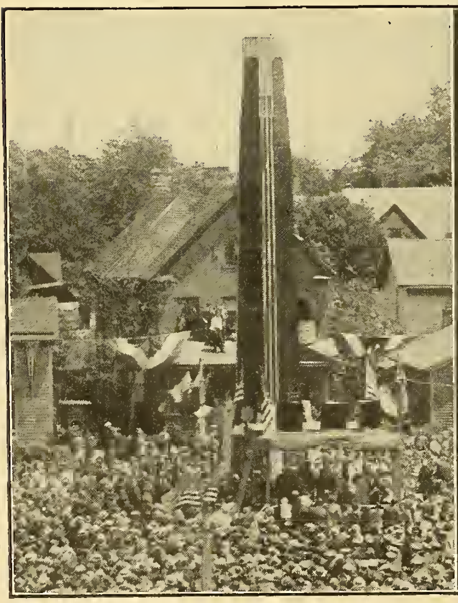
Fashioned of polished black Minnesota granite the shaft of the monument towers forty-eight feet above its many-sided base of pink granite. The contrast of the black, graceful shaft and the broad, gleaming base produces a regal and striking effect. On the north, south and east sides three sets of steps lead up to the wide walk surrounding the base. The corners of the shaft are embellished with structural ornament of cast aluminum. From this height the ornament is carried in three slender shafts of polished metal to the apex.

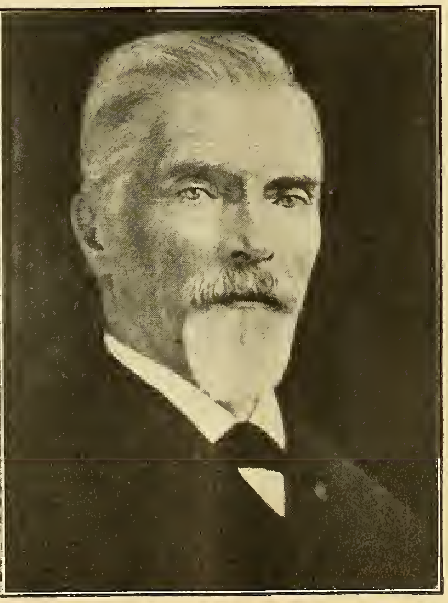
At night these will be lighted to a soft glow by concealed illumination and will blend with the lighted tip of the monument. It is this surmounting section that is the key to the entire monument. Here in flashing glass and silver, lighted at night from within the shaft, is the symbolic portrayal of Captain Lomb's philanthropies. The simplicity and beauty of the whole expresses a simple life, beautifully lived, that brought the bright light of sympathy into the darkness of many another life.

The uniquely designed park in which the Lomb Memorial stands is made up of three triangles, separated by the roadways leading to the Bausch Memorial Bridge. It was by the unanimous agreement of the Council of the City of Rochester that this park was named the Lomb Memorial Park. The monument itself is the gift of the members of the Bausch and Lomb families.

On each of the four sides of the shaft are inscriptions, expressing Captain Lomb's varied interests as patriot, philanthropist and founder of many of Rochester's institutions for the building of health and character.

It is estimated that a crowd numbering more than 40,000 was present at the dedication ceremony.





New Equipment and Appliances

G. E. Develops New Incandescent Lamp Construction

The Nela Park Laboratories of the General Electric Company have created a new simplified construction for high-wattage incandescent lamps which differs radically from the fundamental concepts of lamp design as followed ever since Edison built his first lamp.

When the movies made demands for high-powered lamps in sizes far above standard practice, the development followed, naturally, along lines of old-established usage. But when we consider that some of the largest incandescent lamps made contain three pounds of heavy tungsten metal or enough to make forty-thousand 50-watt lamps, the matter of filament weight introduces an entirely new factor in lamp design and construction.

The new lamps, because of their simplicity of design and construction, are more rugged than the old types and consequently better qualified to meet the severe demands made upon them in studio service. This outstanding characteristic is attributable to a design eliminating from the new lamps all of those parts which in the older types were centers of weakness.

Major Changes

The major changes which contribute to this greater ruggedness are:

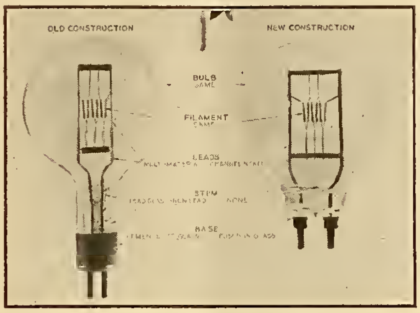
The omission of the conventional base which had to be secured to the bulb by cement or clamping. In the new lamps bi-post bases are used. This base consists of a glass cup with two metal posts sealed to it. Connection to the socket is made through the lower part of the post, which consists of a cylindrical prong with a shoulder for accurate seating.

In the old construction, the filament and leading-in wires were supported by a glass stem structure, with leading-in wires for the current fused in the glass stem. This necessitated the use of special glass and special leading-in wire material having a coefficient of expansion which matched that of the special glass. To get the heavy current into the bulb it was necessary, therefore, to have a section of copper, a section of tungsten, a section of nickel, and in some types a section of molybdenum making up the leading-in wire.

In the new lamp, the stem seal is eliminated and the supporting structure is made from one piece of channel nickel. This construction gives maximum strength to the long leads carrying the heavy filament and also provides maximum exposed surface to dissipate the heat and thus prevent overheating of the metal.

The special heat-resisting glass which was necessary for the stem seal material, on account of its expansion characteristics, required the bulb material to be of this same glass also, in order to make a reliable seal between the bulb and stem.

Unfortunately, this particular glass when heated above a certain point, devitrifies and turns white, causing premature failure of the lamp; now a special heat-resisting glass which does not devitrify is coming into use. In order to use this more desirable glass in bulbs, it is necessary to make a splice between the two kinds of glass in the stem tubing and great technical skill is necessary to do this satisfactorily.



In the new lamp, the metal prongs which hold the lamp in the socket or adaptor have the nickel channel leads welded directly to them and thus they carry the weight of the entire metal structure, where formerly the glass assumed the burden. These prongs also carry the weight of the bulb through the strong pressed glass cup to which they are fused.

Focusing Difficulties Eliminated

Many of the higher wattage lamps are used in projectors or equipment requiring accurate positioning of the source with relation to reflectors or lenses. In the older lamps, there were two points of weakness to contend with. The connection between filament mount and bulb was made in a plastic medium and the base was then placed on the bulb to provide as much correction as skill and the nature of the materials would permit.

In the new lamp the relative position of base and light source is determined entirely by metal working accuracy. It is inherently a prefocused lamp. The parts are built up starting with the base and ending with the bulb being sealed on as a final operation. In mounting the filament, the base and leading-in channel pieces are placed in a mechanical jig so that the shoulders of the prongs are in a fixed plane. It is then possible to locate accurately the filament with reference to this plane and the center line of the mount.

Through the elimination of the base, the heavy leading-in wires and the large stem, the new lamps are considerably lighter in weight and shorter than their predecessors. Non-devitrifying glass bulbs, which stand up better under high temperatures, make possible the use of bulbs of minimum size. This makes possible the storage of a greater number in a given space, and is a decided advantage in the studios where space is limited.

RCA Victor to Install Sound at Rockefeller Center

Contracts providing for the most complete system of sound reproduction and amplification ever designed for theatres have just been awarded to the RCA Victor Company, according to an announcement made by Rockefeller Center, Inc., holding company for John D. Rockefeller, Jr. These contracts call for the installation of all the necessary sound equipment in the International Music Hall and the RCA Photophone sound reproduction in the RKO Photoplay Theater, on the Radio City side of Rockefeller Center.

The installation, when completed, will embrace a public address system, annunciators, projection booth sound apparatus, rear stage reproduction, seat phones for the hard-of-hearing, and custom built film phonographs for the reproduction of sound effects.

In the projection booth the equipment will consist of an 80-watt double channel unit with four, all AC operated, sound motion picture projectors.

The rear stage sound reproducing equipment, consisting of two sound channels, will be used for the reproduction of sound effects in connection with stage productions of the International Music Hall.

B-L Type "F" Rectifier

A new addition to its line of dry metallic rectifiers has just been announced by the B-L Electric Company of St. Louis. The new unit, which is to be known as the Type "F", expands the field of application for rectifiers of this construction.

The unit constitutes a single stack full-wave rectifier. It is assembled on a ¼ inch bolt and the maximum diameter of the discs used in its construction is ⅞ of an inch. Connections to the device are made by means of tinned soldering lugs. To supply the input to the rectifier from 110 volts A.C., a small transformer is required. The unit is marketed in three sizes with a D.C. output of from four to nine volts, one hundred to two hundred and fifty milliamperes.

Interesting Booth Displays at Columbus Convention

Three manufacturers and only one publisher took advantage of the arrangements made in Columbus for exhibiting their products during the I. A. T. S. E. Convention there the week of June 6 to 11.

Of the four booths one was occupied by the National Carbon Company with popular Bill Kunzman in constant attendance explaining the various types of National Carbon products that were on display. This booth offered a valuable education to inquiring projectionists and hundreds took advantage of the opportunity to make themselves more familiar with this company's merchandise.

Another popular booth contained the products of the Capitol Stage Lighting Company of New York. Mr. Ed Altman, head of this organization, took personal charge of his booth throughout the convention period. As a good showman, Mr. Altman did not neglect to use his exhibited items to their fullest. An illuminated fountain gushed real water, a crystal ball cast its reflections all around the hotel lobby and a group of his spots helped to illuminate the exhibits in neighboring booths. This exhibit also attracted a great deal of attention.

Booth No. 3 was occupied by the Mancall Publishing Corporation. Here was displayed the full line of technical books published by this organization having to do with projection. On display also was the MOTION PICTURE PROJECTIONIST, known far and wide in the projection craft and subscribed to by thousands of I. A. members. This booth attracted nearly all the operator delegates in Columbus. Many renewed their subscriptions to the publication here and many others became subscribers here for the first time. As an added feature of the exhibit every book on display was priced at one dollar regardless of retail price. As a result the total number of books purchased at the exhibit was well over a thousand. In some cases representatives of local unions ordered whole sets for each one of their members to be forwarded from New York.

The fourth booth was occupied by the Brenkert Light Projection Company which exhibited its newest types high and low intensity lamps. The booth was under the personal supervision of Mr. Karl Brenkert, president of the company.

Eberhardt Writes a Thriller

Walter F. Eberhardt of the Public Relations Department of Electrical Research Products, Inc., widely known in press circles for his ability to clothe even the driest of sound technicalities with a cloak of romance, has turned his facile pen to literature with the result that his first novel, "A Dagger in the Dark," published by William Morrow & Co., is being hailed by critics and connoisseurs of detective fiction as the hit of the season.

The dagger, as has been aptly observed by one reviewer, "is delivered on page 4" and from thence forth the story moves "like nobody's business." The yarn is crammed with a rapid succession of events, culminating in the solution of the mystery by a private detective whose talents are whetted by the fact that he himself appears to be the next best bet as a candidate for the killers.

Although a first novel, the story is far from being the work of an amateur, Mr. Eberhardt having had considerable experience in the novelization of motion pictures. The book is recommended as an unflagging companion for vacationists and for those who would like to be vacationists. The autograph line forms on the right.

Portable Arc Lamp

(*Continued from page* 24)

The optical system comprises an elliptical mirror 6⅝ inches in diameter, having a working distance of 4 inches from the arc crater to the vertex of the mirror and 19 inches from the mirror to the film aperture. This gives a working speed to the optical system slightly faster than *f*/3, which is sufficient for the quarter-size lenses regularly supplied with portable projectors.

The mirror is adjusted for horizontal and vertical alignment of the spot at the film aperture by means of two knurled knobs projecting from the back of the lamp house, as shown in Fig. 3.

This lamp is designed for use with either standard 35 mm. or with 16 mm. film. The arc current required will vary with the width of the film used and the size of the projected image.

The diameter of the carbons is determined by the arc current. The following table indicates the correct carbon trims for different conditions of operation.

Positive Carbon	Negative Carbon	Arc Current	Film Width
7 mm.	5 mm.	9 amp.	16 mm.
9 "	6.4 "	13 "	35 "
10 "	7 "	15-16 "	35 "

Under the operating conditions indicated in this table, the lamp will produce a screen brilliancy comparable with that produced by standard theater equipment at equal current. Ample illumination is provided for the projection on perforated screens of an 8- to 12-foot picture from standard 35 mm. film. On a solid screen the intensity of illumination is ample for a picture 14 feet or more wide.

To avoid the possibility of trimming improperly, the lamp has been designed to accommodate carbons 4 inches long, when clamped at their extreme ends. This arrangement eliminates any necessity of adjusting the carbons in the holders during the burning period of slightly more than an hour.

In trimming the lamp, the spring clutch is released, the carbon is placed against a stop at the back of the holder, and the clutch is then allowed to engage the carbon. By confining the carbon length to 4 inches, a perfect alignment of positive and negative carbons is assured without any necessity of adjustment.

The interior mechanism of the lamp is shown in Fig. 4. It should be noted that the parts are few in number, as well as simple and sturdy in construction.

To avoid the necessity of purchasing carbons of special length, and so as to permit the use of standard 8-inch carbons, a cutter is provided at the rear of the lamp house. By using this cutter, standard 8-inch carbons may be scored and broken to exactly 4 inches in length.

Should an experienced operator, who understands the readjustment of carbons in the holders, desire to use the full 8-inch carbons, the stops can easily be removed from the back of the carbon holders, and a tubular guard can be attached to the rear of the lamp. This arrangement will prevent contact of the end of the negative carbon which extends through the mirror.

Other Features

An opening is provided in the bottom of the lamp house for connection to the ventilating system provided with some makes of portable sound equipment. The exhaust from the lamp house is carried out through a chimney at the top.

An ammeter is mounted on the rear of the lamp house (Fig. 3). This is surrounded by a ventilating duct that connects to an annular passage around the main ventilating flue. In this manner an induced draft of cool air is drawn in around the ammeter, to maintain the instrument at normal temperature and prevent any disturbance of its calibration.

The rectifier has been chosen as a means of converting alternating current to direct current because of its light weight for the required capacity, its freedom from moving parts and intricate mechanisms, and its simplicity and safety of operation.

The rectifier, herein described and shown in Fig. 5, was developed particularly for use with the lamp described above. Its elements comprise a special transformer for changing the alternating line voltage to the correct potential for operation of an arc; a radial switch for regulating the current to the desired value; two Tungar tubes for rectifying the current; a substantial housing; and necessary sockets and lead wires.

The transformer is of a special design in which the output possesses constant current characteristics, thus allowing commercial fluctuations of line voltage without affecting the stability of the arc. The primary and secondary coils are separate and are effectively insulated from each other, which construction allows only the low voltage necessary for operating the arc to enter the lamp house, thus avoiding any possibility of the operator's sustaining an electric shock.

The rectifier tubes are of the familiar Tungar type, *i. e.*, thermionic tubes filled with argon at low pressure. These tubes provide a valve action, permitting the alternating current to pass in one direction only. Connection is made in such a way that full-wave rectification is secured without the use of moving parts, relays, or other intricate devices.

A radial switch, placed within convenient reach, gives eight points of current adjustment. This permits the arc current to be adjusted to values ranging from 8 to 16 amperes when the rectifier is connected to a 115-volt supply.

The electrical efficiency of the rectifier unit is 80 per cent. From this fact, it is evident that the lamp may be operated at an arc current of 15 amperes with a line consumption of only 1,000 watts.

Motion Picture Film In the Making

(*Continued from page* 9)

creased the importance of cellulose acetate, made from acetic acid, in the film manufacturer's economy.

Film for these two specific purposes is made from cellulose acetate. The so-called "safety film," rated by the National Board of Fire Underwriters as presenting somewhat less fire hazard than common newsprint paper of the same form and quantity, can be used for amateur movies and X-ray work in homes, schools, and hospitals without the projection and storage precautions necessary with cellulose nitrate film. Lack of the needed equipment for adequate precautions would otherwise have greatly restricted two useful fields of photography.

The growth in the importance of cellulose acetate film has emphasized the relationship of the film industry to a recent rapid chemical development. Cellulose acetate film is more than twenty years old; but its adaptation to important uses dates back less than ten years. Within that period the chemical world has been busy maturing other forms for cellulose acetate. The film maker's subsidiary founded to supply wood alcohol is now making cellulose acetate yarn as well. Transparent wrapping material likewise is taking its place beside film as a utilization of cellulose acetate—and the number of commercial objects that may be moulded from plastic cellulose acetate is unlimited.

Cellulose nitrate—the senior film material—has acquired some cosmopolitan cousins, too, during its long career. Lacquers, artificial leather, and window curtains for automobiles are only a small minority of limbs from that family tree. Perhaps only the novelty of cellulose acetate chemistry, and the fact that it makes more products that look less like film, provides the current industrial glamour of that new alchemic realm.

The very fact that film chemistry is looking afield from its constituted line of achievement—and that this series of articles seems to end remote from its main theme—points an observation: that the film industry has its eyes open. A related field that may contribute sidelights of knowledge to photographic research's vast store must pass in review. A "by-product" business that can increase the manufacture of controlled-quality raw materials for film "broadens the base" of the film industry. In the raw stock industry as in the projection booth, film is the primary consideration.

(THE END)

Selsyn Motor Applications

(*Continued from page* 7)

of its position, and there is always some voltage on the secondary leads which matches the voltages on secondary leads of similar units connected to the same line. This voltage will supply equal interlocking power throughout a complete revolution. In the two or three phase units the primary field rotates as in any polyphase machine and the voltage induced in the secondary which is used to interlock it with other machines is then three phase.

The Master Unit

It is standard practice in polyphase systems to drive the master unit or distributor, and have it drive in turn the various motor units connected to it in the same direction in which they would rotate as induction motors. In this way the current flowing through

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO.. 844 So. Wabash. Chicago.

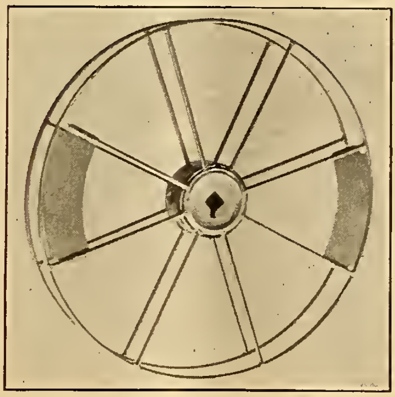
for Unexcelled Performance

TELEPHOTO
PHOTOELECTRIC CELLS

For talking picture operation, it is essential that the tube should have a high signal output with an absence of "rush" noise or similar disturbance. . . . Telephoto Photoelectric Cells of the Caesium Argon type meet this requirement in an exceptionally high degree—for each cell is constructed under the most careful supervision of trained laboratory experts and is subject to a final test after having undergone a special ageing process.

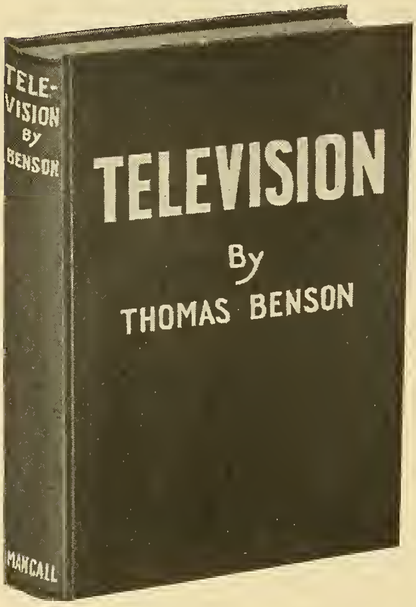
MADE IN ALL TYPES AND SHAPES
PAMPHLET ON REQUEST

Telephoto & Television Corp.
133-135 W. 19th Street New York



16 MM
FILM REELS
FOR PROFESSIONAL AND
HOME MOVIES
—ALSO—
35 MM SOUND REELS
10"—11"—14"—15"
UNIVERSAL
ELECTRIC WELDING CO.
9-16 Thirty-Seventh Avenue
LONG ISLAND CITY, N. Y.

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today. It is a book both for the interested layman and for the craftsman who will shortly depend on television operation for his livelihood. It has been written especially for the motion picture projectionist who will unquestionably operate television in the theatre as he now does sound equipment. The serious projectionist will get a copy at once.

Some of the Contents

- —Elements of Visual Communication
- —Light Sensitive Cells
- —Scanning Methods
- —The Television Signal and its Amplification
- —Transmission Channels for Television
- —Light Sources for Television Reception
- —Reproducing the Image
- —Synchronizing Methods
- —Stereoscopic and Color Television
- —Experimental Television

TELEVISION
By Benson $2.00

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th Street, New York City
Enclosed find money order for $2.00.
Please send me Benson's Television.

Name ....
Address ....
City and State..............................
Theatre ....

the secondary winding producing interlocking power also causes the unit to deliver power as an induction motor and help the motor driving the distributor to carry the load.

In turning on the exciting power on a polyphase system it is necessary first to apply power from one phase which pulls all machines in line, then apply the polyphase power. If the polyphase power is applied with some of the units off position a heavy surge of current will flow through the secondary circuits producing a rotating action as an induction motor sufficient to cause it to break the interlock and run up to speed as an induction motor.

Perhaps the largest installation using interlocked motors is the one which operates the massive gates of the Panama Canal Locks in such a manner that they close simultaneously, and their edges meet at the closing point without variation.

In conclusion I would recommend that problems of remote action or control with which engineers are frequently confronted can be readily solved by the use of interlocked electrical units plus, of course, the necessary native ingenuity to apply these units in the right place and proper manner.

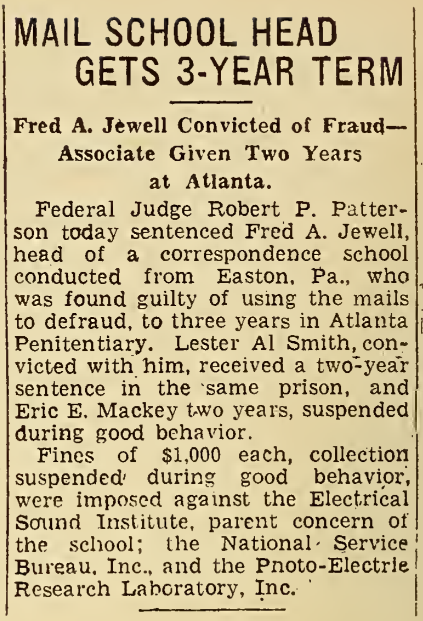
Theory and Fundamentals

(*Continued from page* 25)

The question immediately arises as to the height of the picture for projection angles other than zero degrees. For this purpose the following table has been prepared. It shows in tabular form the ratio of the height to width of picture to be expected for the various projection angles indicated. This table, of course, is prepared on the basis of a screen mounted vertically and a projection angle measured from a horizontal.

Projection Angle	Picture Ratio
0	0.728
5	0.730
10	0.740
15	0.753
20	0.775
25	0.803
30	0.840
35	0.889
40	0.950

The above table will be found very useful in determining the height of picture to expect for any given projection angle. Once the picture width is determined as described above it is necessary only to select the proper ratio corresponding to the desired projection angle and multiply the picture width by this ratio. For example, determine the picture height for a picture width of 20 feet and a projection angle of 10 degrees. The height will equal 0.740 times 20 feet or 14.8 feet.



MAIL SCHOOL HEAD GETS 3-YEAR TERM

Fred A. Jewell Convicted of Fraud—Associate Given Two Years at Atlanta.

Federal Judge Robert P. Patterson today sentenced Fred A. Jewell, head of a correspondence school conducted from Easton, Pa., who was found guilty of using the mails to defraud, to three years in Atlanta Penitentiary. Lester Al Smith, convicted with him, received a two-year sentence in the same prison, and Eric E. Mackey two years, suspended during good behavior.

Fines of $1,000 each, collection suspended during good behavior, were imposed against the Electrical Sound Institute, parent concern of the school; the National Service Bureau, Inc., and the Photo-Electric Research Laboratory, Inc.

THE newspaper item illustrated above recently appeared in the New York *Times*. It marks the culmination, in this case, of a two-year battle against the spurious correspondence school which swept down upon the projection craft with the coming of talking pictures.

This particular case came to the attention of the projection field when Fred A. Jewell, who now stands convicted, appeared in the offices of the MOTION PICTURE PROJECTIONIST over two years ago to seek its support for his school. Sitting opposite the publisher of this paper he criticized the quality of sound projection throughout the country, making an especial point of disparaging the work of union projectionists.

He was informed that he lacked the experience to teach others and that his plans for a correspondence school were insincere and calculated only to take money away from the unwary.

Boone Mancall, publisher of this paper, called upon the International officers and at his suggestion the International Bulletin carried a warning to all Local Unions in the I. A.

One projection paper accepted Jewell at his own statement and for a time assisted his projects by full page advertising.

The MOTION PICTURE PROJECTIONIST is glad to report the final outcome of this case. It is hoped that it will serve as a warning to any others who may be planning to foist their dishonest projects upon motion picture projectionists.

Lamp Coating Remover

A compound which, it is claimed, will not injure the hands, is non-inflammable, and will remove old lamp color coatings, has been placed on the market by Kliegel Bros., of New York.

Local 306 Conducting Advertising Campaign of Vindication

Characterizing the critics of New York Local 306 as "labor's enemies, malcontents and agencies ill-advised and misinformed" who have "spread slander that officers and men of Local 306 are racketeers," Sam Kaplan, president of the organization, has issued a strong public statement in the form of an advertisement which is being run in a goodly portion of the New York City newspapers. Mr. Kaplan's rebuttal reads:

"As workers affiliated with the International Alliance Theatrical Stage Employes and the A. F. of L., Union Local 306 has heretofore scorned to reply. But in behalf of its members who, voluntarily, have undertaken to pay for their day in court, through this and other newspapers, we brand the characterization as undeserved, libelous and maliciously cruel.

"Local Union 306, its officers and members are *unqualifiedly* against violence, threat or coercion in any form.

"Local Union 306 is composed of technicians, each an alert guardian of your safety in the moving picture theatre, each pledged to operate the projection machine only under conditions offering maximum safety for yourself, your wife and children.

Racketeers?

"Analysis of our membership shows that: Of its 1300 members, 1200 support families, including 2300 dependent children.

"Of the children, 850 attend elementary schools, 420 attend high school or college, and 103 have achieved professions.

"Seventy-five members are helping relatives or their children. More than 300 members own their homes; 700 carry life insurance in addition to the Union death benefit. Four hundred members have attended institutions of higher learning, 225 studying for professions; 1270 are citizens of the U. S. A. and 30 have their first papers; 300 have served in the Army, Navy or Marines. Local Union 306 came into being with the moving picture industry. Its men keep fully abreast of the technical phases of the work, which, according to authorities, may, in less expert hands, prove dangerous to *you, your wife or your children.*

Expert Testimony

"Are we racketeers because we stand with one of America's leading technicians in requiring adequate crews in attendance at the projection machine? This man, directing the work of 355 projectionists in one of the largest theatrical chains operating in the U. S. and Canada, recently testified under oath in the Supreme Court:

"'Film is highly inflammable . . . passing through a temperature of thirteen hundred degrees, a six-second stop of the film may mean a fire, igniting the whole film. For absolute safety, an expert projectionist should be in constant attendance. . . .

"'Film must be slowly and carefully inspected when rewound . . . bad spots resulting in breakage are dangerous . . . it is necessary that the

HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.

H&C INC.

• 13.6 mm x 22 inch •

One more double reel per trim

3 less carbons per twelve hour day

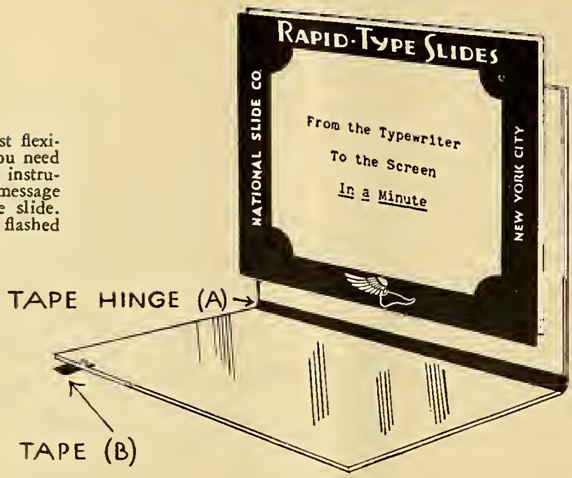
These results are reported by projectionists using the new 13.6 mm x 22 inch National High Intensity Projector Carbons.

No increase in price

Improved manufacturing facilities permit this new length to be offered at the same price as the 13.6 mm x 20 inch carbons formerly supplied.

NATIONAL PROJECTOR CARBONS

NATIONAL CARBON COMPANY, INC., Cleveland, Ohio
CARBON SALES DIVISION
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York, Pittsburgh, Chicago, San Francisco



A RAPID-TYPE SLIDE is the most flexible screen vehicle available. All you need is a typewriter. Any dull pointed instrument will do equally well. Your message takes a minute to transcribe to the slide. In another moment its message is flashed to the patrons in your audience.

Talk to Your Audience

Use daily for announcing:
baseball results
contests
requests for silence
songs
publicity for community drives, coming pictures, etc.

Typewriter slides are being used more and more during this period of extreme economy when everyone's main thought is to SAVE MONEY. RAPID-TYPE SLIDES tell your story just as accurately as a trailer and very much more cheaply. Make announcements from your screen with a minimum of effort and expense, and a maximum of speed and efficiency.

We live in a hectic world. Great news events move upon us minute by minute. Now it is a round-the-world flight. Next minute it is a great earthquake, a revolution, a big man dies, a sudden change in government, a sensational murder, the local ball team wins—or loses—this is the stuff that grips your patrons. Snap up your show with up-to-the-minute news. Give it to them red-hot as it flashes into your town.

A RAPID-TYPE SLIDE can be used in a hundred different ways.

Snap Up Your Show

With

RAPID-TYPE SLIDES
manufactured by
NATIONAL SLIDE CO.
NEW YORK CITY

From the Typewriter *To the Screen*

Ask your nearest theatre supply dealer or write direct to

NATIONAL SLIDE CO., 7 WEST 44TH ST., NEW YORK CITY

film pass through the expert fingers of a projectionist to detect dangerous breaks. Projection and rewinding are simultaneous operations. It is, therefore, necessary to have two operators in the booth at all times.'

"Mindful of your safety, we subscribe fully to the testimony of this expert. Local Union 306 is, in turn, supported by the following theatres employing in their projection booths full crews recruited exclusively from the membership of Motion Picture Machine Operators Union No. 306.

(Signed) Sam Kaplan,
President."

Following the author's signature are the names of over two hundred and fifty metropolitan theatres and a dozen studios.

Vacuum Tubes

(*Continued from page* 20)

of 95 decibels below 1.0 volt, the corresponding value of the emission noises of both tubes being approximately 95 decibels below 1.0 volt.

The improvements in microphonic noise level have followed an analysis of the resonances occurring among the various elements of the tube structure, and have been made by designing structures that avoid such resonances. It was found that a rigid structure built as close to the stem press as possible exhibited very little tendency to resonate. A structure in which the three elements were bound together as rigidly as possible and mounted as close to the glass stem as practicable was, therefore, adopted. For reasons of interchangeability, it was necessary to limit the size of the parts to dimensions suitable to the over-all dimensions of the 239A tube, which it was replacing, and also to permit the use of the small push type base.

Permits Rigidity

With these limitations it was possible to obtain a more rigid and lower mounted structure by using a special means of constructing the glass stem press. Due to the dimensional limitations, it would not have been possible to use glass tubing for the stem press of greater average inside diameter than 0.53 inch. With such tubing, and with standard methods of stem construction, the maximum distance between the two plate supports would be approximately 0.53 inch.

With new means of stem construction it was possible to use the same size of tubing and to make a stem press in which the distance between the plate supports was 0.64 inch. In order to obtain this plate support spacing with standard methods of stem construction, it would have been necessary to have used a stem tubing whose mean inside diameter was 0.66 inch. It would not have been possible to have sealed a stem made from such tubing into a bulb that could have been used with the small push type base.

Fig. 8 shows, in solid lines, an outline of the stem press for the tube using the 0.53 inch tubing and, in dotted lines, the stem press that could be made with this size of tubing with standard stem construction practice.

It is evident that the base of the mounting has been increased from 0.53 to 0.64 inch, adding considerably to the rigidity of the structure and making possible the use of straight plate support wires. By using the straight plate support wires, the assembly can be mounted closer to the stem press with greater facility than when the plate support wires are bent outward. The increased distance between the plate supports makes possible a greater separation between the leads and permits the insertion of adequate shields above the stem press to maintain insulation paths free from thin films of vaporized material. The thin films of vaporized material on the glass produce variable resistances which contribute to the sputtering noise as described above.

Filament Mounting

The filament and its mounting contribute materially to the agitation noise. If the filament is placed under considerable tension so that the contact between the filament hook and the filament is maintained at all times, the production of sputtering noise at this point is eliminated. However, the degree of tension to which the filament is subjected materially affects the level of the microphonic noise deriving from the filament unit. In general, the higher the tension, the greater the microphonic noise level. It is, therefore, necessary to balance the two requirements.

With zero tension a considerable number of the tubes will give evidence of sputtering noise originating at the filament hook, whereas a minimum of microphonic noise will result from the filament unit. As the tension is applied and is gradually increased, the microphonic noise deriving from the filament unit will also increase. A spring and hook unit has, therefore, been adopted which will place the filament under a tension of a few tenths of a gram, and will have adequate displacement to keep the hook and filament in contact. In this way both the microphonic and sputtering noise of the filament unit are kept at the lowest practicable level.

All welds in the structure which are a part of the electrical circuit are made with special care to assure the elimination of variable resistances. As described above, the stem press is shielded against the deposition of material from the filament or from the metallic parts during pumping. This shield prevents throughout life the formation on the stem press of thin film resistances that are variable and

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

It is no exaggeration to say that our rheostat is internationally famous.

Four out of every five theatres in this country use Hoffmann-Soons Rheostats *exclusively.*

A first class product, backed by reputation and guarantee. It always leads the field.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Specialists

RHEOSTATS

SUN-ARC CARBONS

for

PERFECT PROJECTION

"Best by Test"

BIG SAVINGS—COMPLETE SATISFACTION

Casco Carbon Saver for Hi-Low and Hi-Intensity carbons, FREE OF CHARGE. Permits the burning of carbons down to 2" and less.

Carbons furnished *ready for use.* No inconvenience whatsoever for the operator.

Samples on request. Address

CARBON PRODUCTS, INC.
324 West 42nd Street New York City

Good Projection Requires Good Rectification

M. P. 25-25

Good Rectification Means

FOREST RECTIFIERS

THIS Forest Rectifier meets the demand for a single unit to supply direct current for two projectors, and will furnish 15 to 25 amperes to either projector continuously.

It supplies a steady direct current, free from pulsations, and will produce a better light than other current supply devices. The only wearing parts are the bulbs which will last at least one thousand hours and usually much longer since only two bulbs are being used at a time (except during change over) and the load is alternately carried first by one set of two tubes, then the other two, as the projectors are alternately used.

This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other, thus preventing loss of current at the first arc when the second arc is struck.

Both arcs can be operated at the same time during the change over period and there will be no diminishing of the light from one projector while lighting up the second.

Two Ammeters are mounted on the unit which will show at a glance the amperage being used at either arc.

Links are provided for operating from 110-220 or 240 volts.

Rectifiers for all purposes made in 15 amp., 25-25 amps., 30, and 65 amps. sizes.

We are specialists in our field. Send us your technical problems. Literature on request.

FOREST ELECTRIC CORP.
New and Wilsey Sts.
Newark New Jersey

produce the sputtering noise. The glass insulator tying the parts together at the top of the structure is located at the back of the plate so that no material from the filament can be deposited across insulating paths during the life of the tube.

A Double Anode Rectifier

By operating the vacuum tubes of sound reproducing amplifiers on alternating current, only a portion of the storage battery equipment that is necessary in the projection of sound films is eliminated. The sound lamp is heated by direct current, and because of its high current rating requires considerable storage battery capacity.

A rectifier tube, which has been coded "Western Electric 263A," has been developed to supply the direct current for the sound lamp and thus completely to eliminate the storage batteries from reproducing equipment. It is shown in Fig. 9. The rectifier tube has two anodes and a filamentary cathode of the oxide-coated type. The filamentary cathode is mounted between the two anodes, with its housing so arranged that the necessary peak potential can be obtained between anodes without voltage breakdown. The tube is filled with argon at a sufficiently high pressure to give the minimum anode-cathode potential drop during the conducting half of the cycle. The characteristics of the rectifier tube are as follows:

Filament potential	2.50	volts
Filament current	16	amperes
Anode-cathode potential	5 to 10	volts
Max. value of peak space current	6	amperes
Max. p'k potential betw'n anodes	100	volts

With a suitable filter system this tube will supply a direct current of 4.0 amperes. The available d-c. potential will, of course, depend upon the voltage drop in the filter system. With a filter system designed to give direct current with a ripple small enough to permit the output to be used for heating the filaments of vacuum tubes, a voltage of 15 to 20 volts should be available when the peak voltage between the anodes does not exceed 100 volts.

High Sensitivity P. E. Cell

The photoelectric cells initially used in sound picture reproducing systems were filled with gas and were of the potassium hydride cathode type. They were operated with an anode potential of 90 volts. The average cathode sensitivity of the potassium hydride surface was 1.0 microampere per lumen for a light source having a color temperature of 2710°K. The gas was maintained at such a pressure that a gas amplification of approximately 4 was obtained at 90 volts, giving an output current of 4 microamperes per lumen for the light source described above.

It was recognized from the beginning that a photoelectric cell of higher sensitivity would be of material assistance in reducing background noise. Any increase in the level of the photoelectric cell output would proportionately decrease the necessary amplification by vacuum tubes and thus increase the ratio of the signal to the noise deriving from the amplifier tubes in the output.

The potassium hydride photoelectric cell, in addition to having a lower sensitivity than was desirable, had other inherent properties that were not ideal for a commercial device. A potassium hydride surface, even when made under the most favorable conditions, exhibits on standing a gradual decay in surface activity. This decay is due to the covering of the hydride surface by a film of potassium. This coverage is accelerated by an increase in temperature. In commercial parlance, this type of cell has a shelf life which is a function of the temperature.

Searches were instituted for cathode surfaces of greater sensitivity and, if possible, free from shelf life characteristics. The work of Langmuir and Kingdon and of Becker on the effect of oxygen films in lowering the thermionic work function of thin films of caesium on tungsten gave a valuable indication of the most fruitful direction of investigation. The use of oxygen as well as of sulphur in connection with thin films of sodium and caesium was found to be effective in lowering the electronic work function of cathode surfaces.

Caesium Used

Manufacturing considerations, such as the cost and the control of quality, led to the standardization of a thin film surface of the caesium type rather than of other surfaces of substantially the same sensitivity. The cathode of the cell so standardized is a silver sheet upon which there is formed during exhaustion, by irreversible chemical processes, a matrix of caesium oxide, silver oxide, and finely divided silver. Upon this matrix there is placed by reversible processes a thin film (of atomic thickness) of caesium.

This cathode surface has a long-wave limit beyond 12,000 A and a maximum of sensitivity at about 8,000 A. This spectral sensitivity makes the surface unusually suitable for use with light from a tungsten filament. With a light source having a color temperature of 2,710°K., the stabilized sensitivity of this surface is approximately 35 microamperes per lumen. The surface exhibits no shelf life characteristics, even at temperatures of the order of 65°C., which is well above normal storing and operating temperatures.

The cell employing this cathode was filled with argon at a pressure suitable for operation at 90 volts plate potential with the light flux normally employed. At this pressure the gas amplification factor at 90 volts is approximately 3.

A CHALLENGE TO EVERY PROJECTIONIST IN AMERICA

More Miehling books have been sold to projectionists than any other. . . . There have been others since Miehling's book was brought out . . . and all at a higher price . . . but Miehling's still remains as the *only book written by a projectionist for projectionists*. . . . That is why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of *all* sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

NOW ONLY

$2

SOUND
PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.

519 pages . . . completely indexed

Do Not Delay! Fill in this coupon and forward to us at once with your remittance. Do it now!

MOTION PICTURE PROJECTIONIST
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $2.00.

Name ....

Address ....

City and State ....

Position ....

Theatre ....

Wise exhibitors have found *it pays*

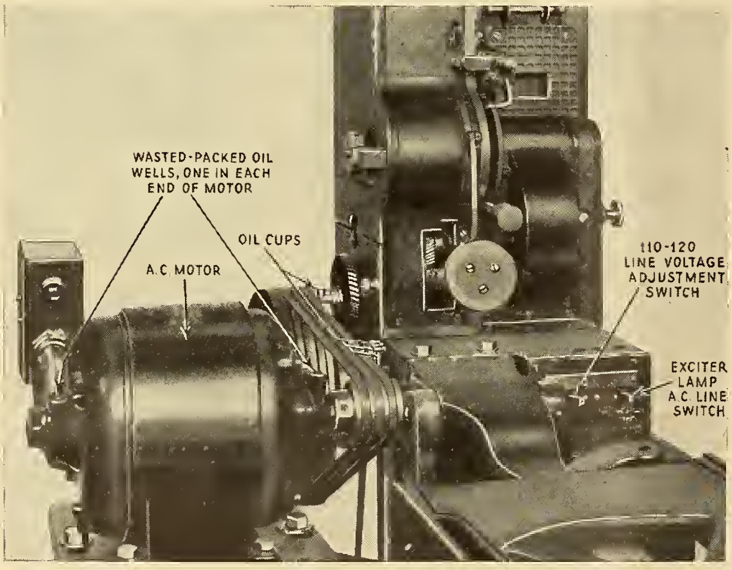
to replace outmoded equipment . . . and so Photophone's business has DOUBLED!

IMAGINE that! More unsatisfactory sound-reproducing equipment replaced in the past six months by RCA Photophone than was replaced in any *entire year* since sound swept its way through the industry!

Why are exhibitors so willing to spend money in these times? There's only one answer . . . IT PAYS! It sends up the admissions and brings down your cost. Nothing tags a theatre "old-fashioned" quicker than break-downs in equipment or poor reproduction!

Photophone is the only AC equipment available for theatres of all sizes. It eliminates the troublesome battery and motor generator.

Photophone has materially lowered lease prices and contract service charges. If you want to make more money out of your theatre, get in touch right away with the Photophone Division, of the RCA Victor Company, Camden, N. J., or with any of the several branch offices.


WASTED-PACKED OIL WELLS, ONE IN EACH END OF MOTOR
OIL CUPS
A.C. MOTOR
110-120 LINE VOLTAGE ADJUSTMENT SWITCH
EXCITER LAMP A.C. LINE SWITCH

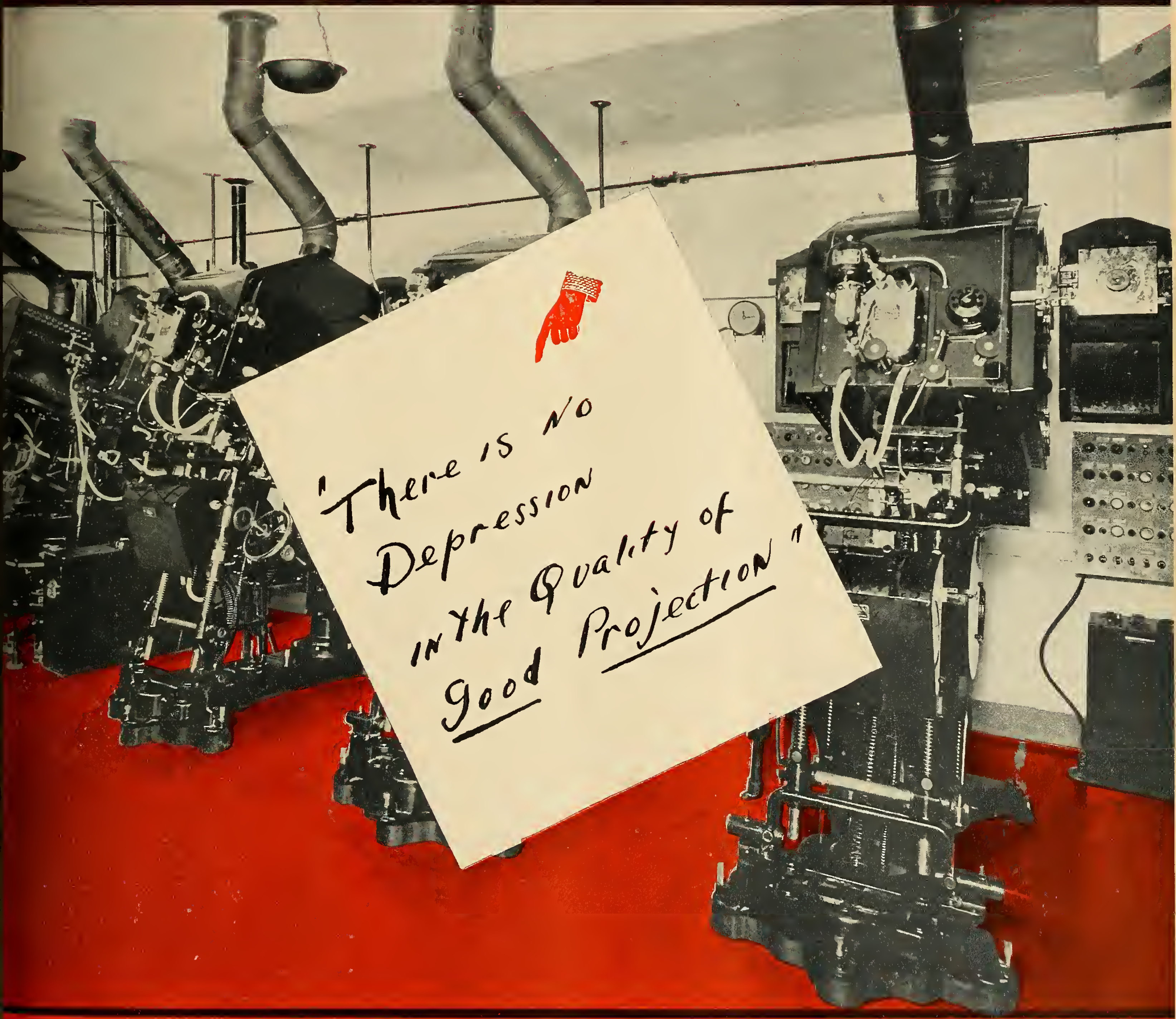
Sound head with improved belt drive for Special Size, Standard Size and Small Size Equipments

RCA VICTOR COMPANY, INC.
PHOTOPHONE
SYSTEM

TRADE MARKS REG. U. S. PAT. OFF.

Photophone Division
RCA Victor Co., Inc.
Camden, N. J.—branch offices in principal cities

MOTION PICTURE PROJECTIONIST



FIFTH YEAR
of
PUBLICATION

Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.*
Editorial and Advertising Offices, 7 West 44th Street, New York City.
Entered at New York Post Office as second class matter, October 25, 1927.

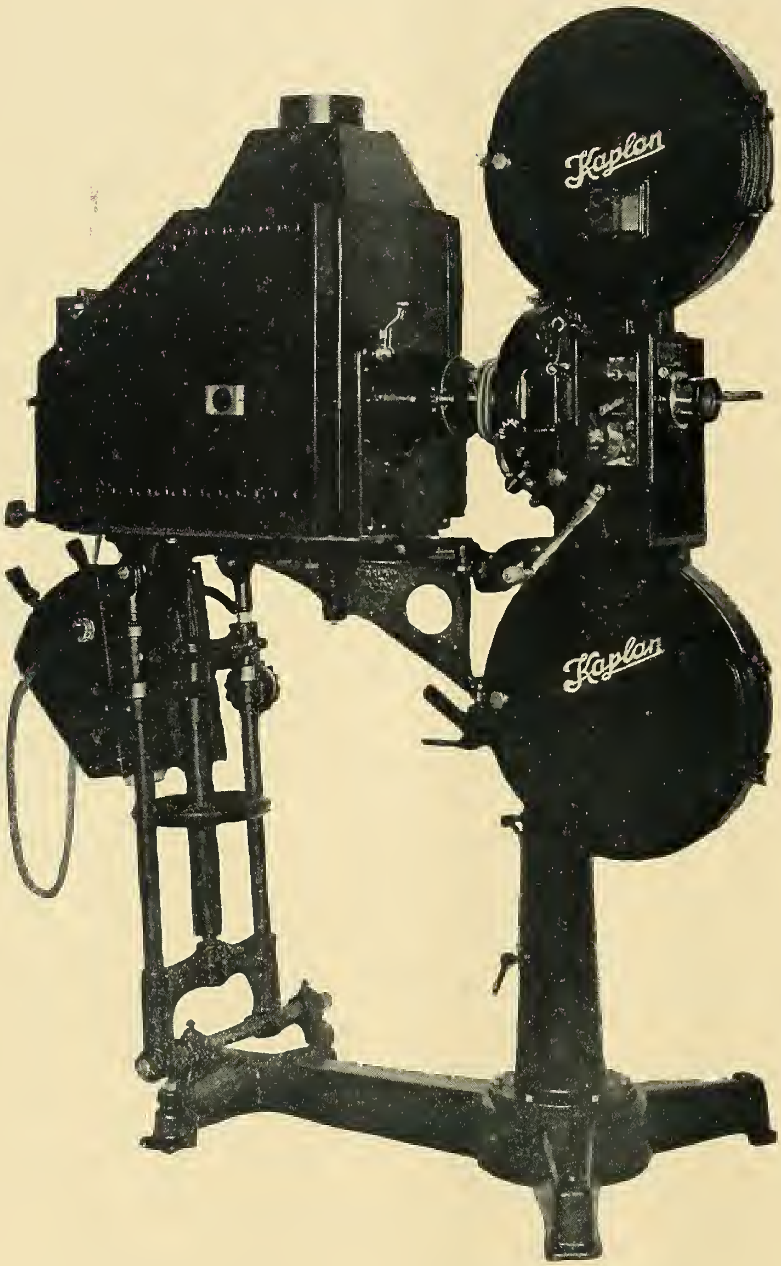
Vol. 5 ▾ No. 10
AUGUST, 1932
25c. per copy -:- $2.00 per year

ANOTHER VIEW of COLOR PHOTOGRAPHY

IN THIS ISSUE

Kaplan

PROJECTORS



Widely used in this country—known internationally, the Kaplan Projector is universally recognized as a product of the first rank. It has earned its reputation because it is designed and built on the best engineering principles.

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue New York City

MOTION PICTURE PROJECTIONIST

August, 1932 Vol. 5, No. 10

EDITORIAL BOARD

IRVING WEISS, *General Supervisor*; LESTER ISAAC, *Efficiency*; J. H. KURLANDER, *Light*; J. E. ROBIN, *Equipment*; W. W. JONES, *Theory*; HARRY RUBIN, *Improvement*; VICTOR WELMAN, *Personnel*; SIDNEY BURTON, *Production*.

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue.

Entered as second class matter October 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth Street
Melbourne, Australia.

Editorial & Advertising Offices
7 West 44th Street
New York City.

National Advertising Manager
Boone Mancall

OUR PLATFORM

To maintain always the integrity of the original policy of this publication: that it be a means of raising the standards of projection by a ceaseless campaign of education among the many thousands of projectionists in the United States and Canada.

That every available inch of space in each issue be devoted to this end.

That we be interested in neither the politics or the personalities involved in the politics of the International Alliance of Theatrical Stage Employees and Moving Picture Operators or of any other group or body of projectionists, because such interference with internal affairs of labor organizations will make this a partisan and political paper and destroy its value to the craft which lies in educational work only.

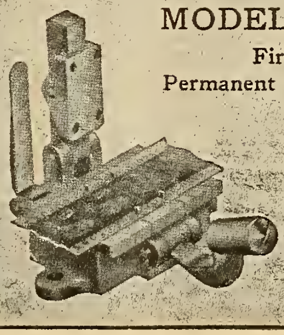
That by maintaining our policy of education we will enjoy the support of projectionists everywhere for many years to come as we have enjoyed this support for the last five years as the leading projection publication in the country.

The Editors and Advisory Editors and the organizations with which they are affiliated do not necessarily endorse all the statements or opinions offered in this magazine. The author who signs an article assumes full responsibility for the statements it contains.

WHY NOT ONE FILM FOR ALL SHOTS?

• • • That question concerns every producer and cameraman. The answer is easy: Use Eastman Super-sensitive Panchromatic Negative **with gray backing** . . . "Inkies" . . . arcs . . . daylight . . . any kind of light is right for this versatile film. Cameramen are rapidly finding that out, and everybody from actor to exhibitor is benefiting from the use of this remarkable all-purpose negative. Eastman Kodak Company, Rochester, N. Y. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN SUPER-SENSITIVE PANCHROMATIC NEGATIVE (Gray-Backed)



Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film

Permanent Gauge No Adjusting

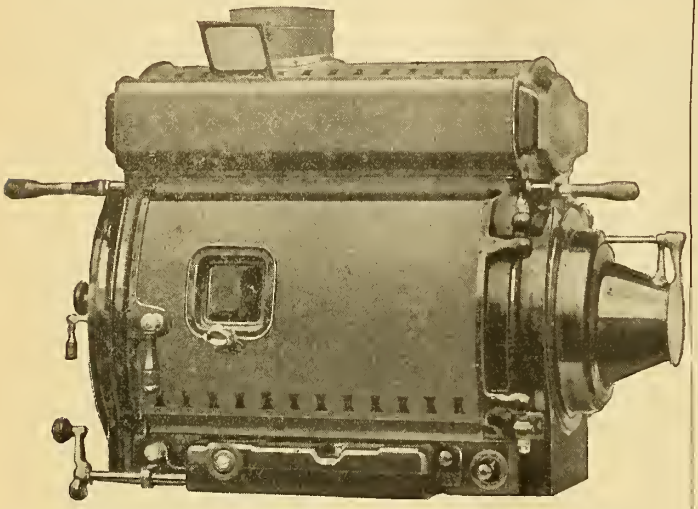
FOR THEATRES, EXCHANGES LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers

Brenkert

High Intensity Reflector Lamp



Consistently Excellent Screen Results are Assured by These Built-in Features

Air-cooled mechanism—Unit construction Oil lubrication to all bearings—Hardened and ground shafts and gears—65 to 85 amperes capacity . . . and many other features contributing to better results, ease of operation and low maintenance.

Distributed by Independent Supply Dealers

WRITE FOR LITERATURE

A Brenkert PRODUCT

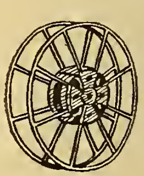
CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

WHY *you can always get what you want at* NATIONAL

WE anticipate your requirements ahead of time and carry them in stock for you. You don't have to wait for service when you trade at National. Genuine repair parts, the latest developments in accessories, the best of supplies,—all are ready for delivery at your National store.

Reels



A wide variety of sizes and makes to select from, at a range of prices to suit every requirement, carried in stock.

Rewinds

The latest developments in automatic and hand rewinding apparatus of all types and for every purpose. The prices are always right.

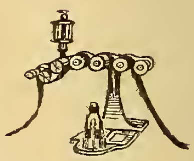
Cabinets

Ruggedly constructed film storage cabinets, designed to facilitate the safe and easy handling of sound film. All sizes. Lowest prices.

Lamps

Exciter lamps; photoelectric cells; power tubes; amplifier tubes, as well as Mazda lamps of standard and special construction. We have them in stock.

Cleaners



Film renovating and patching devices — cleaning supplies — everything you need for better film handling is provided in the National Line.

Ask about our FREE Equipment Inspection Service. It saves trouble and expense.

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

AS I SEE IT

¶ Interesting Material

IN many respects this issue of the MOTION PICTURE PROJECTIONIST is one of the most interesting and constructive numbers mailed to our subscribers. It is at least the most satisfactory.

A survey of the articles appearing herein reveals a well-rounded picture of matters pertaining directly and indirectly to projection. I feel sure that projectionists will find that I am correct in saying that it represents a liberal education.

Mr. Von Fraunhofer gives a masterly exposition of the whole technique of color photography which we have published at length because we felt that it was a necessary contribution to an understanding of the next step in motion picture development. No doubt there will be many who will disagree with the author's view-point but it is informing and complete. Advance notice of the publication of this article has brought many requests from leaders in the industry for copies.

Mr. James H. Davie, one of the founders of the MOTION PICTURE PROJECTIONIST, contributes an article on projection in a far-away part of the world. For several years Mr. Davie was in charge of a section of the sound engineering activities of the largest theatre company in South Africa and is an authority on his subject. Projectionists here will admire the effectiveness of sound reproduction under such primitive methods as he describes.

Mr. Chapman's article *Dynamo Troubles and Cures* is a first class trouble shooting treatise. This article and the one entitled *A Service Engineer Makes His Rounds* by Mr. Irving Weiss and also *Sound Head Troubles* by Mr. Lloyd Harding should be and will be read avidly by every projectionist. Although treating technical subjects each item is simply and lucidly written and form a short-cut hand-book that will, undoubtedly, be used in the projection room as readily as any tool. We are glad to present all three in one issue.

Is It Really Noiseless Recording? is the start of a new monthly feature in which Mr. Kenneth Hiler will answer one far-reaching question in each successive issue of this paper. The question covered in this issue is a prominent one in projection circles. We invite our readers to send in their problems to Mr. Hiler.

Two valuable reports recently published by other journals but not generally accessible to projectionists are included in this issue, following the policy of the MOTION PICTURE PROJECTIONIST, from the very beginning, to give its readers everything of value regardless of origin or previous publication. One of these is called *Projection in Photography* issued by the Academy of Motion Picture Arts & Sciences which explains how the camera photographs directly from a projected image on the screen. This is a new and little known use of the projector and makes exciting reading. It will be concluded in the next issue.

From the Journal of the Society of Motion Picture Engineers we have taken the article headed *Fit the Screen to the Theatre* which many of our readers will find valuable. If any of the details in this report are familiar, it serves, in any case, to recall pointers on a widely discussed subject which has never really been solved to the satisfaction of either projectionist or development engineer.

Articles by Mr. Hargrave, Mr. Lowenstein, Mr. Everett, the patent page, answers to patent inquiries and other items are included for their instructive value.

Last we wish to recommend to the attention of our readers the article called *Laying the "Movie Bogy"* which takes us into a new field, just beginning to grasp and be agitated by the possibilities of the motion picture. When the educational field is truly developed it is my sincere hope that projectionists will find a wide field for the exercise of their knowledge and skill.

¶ Anniversary Issue

THE OCTOBER issue of this publication will mark the start of its sixth year. Looking back to the first issue in 1927 I am moved to wonderment at the changes that have taken place in so short a time. When we say 'Projection' today we mean something vastly different from what was implied before the sound era.

The October issue will review the past five years in the projection craft and the advances in technique and equipment. Prominent authorities will also indicate future trends. Any subscriber failing to receive a copy of this valuable number should write in at once.

Boone Mancall

Another View of Color Photography

By HANS VON FRAUNHOFER

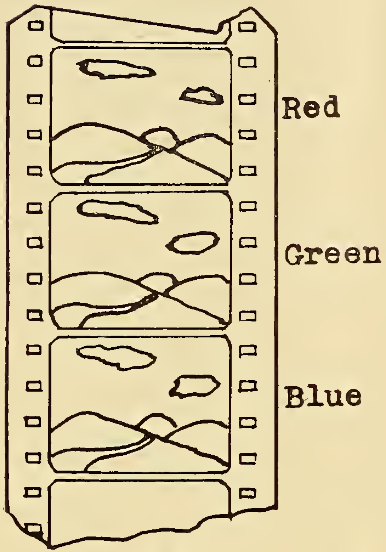


Figure 1

THE fundamental principle upon which all processes of color motion pictures, color photographs and color printing methods depend has remained unaltered since its discovery and introduction by Clerk Maxwell before the Royal Institute of England. Maxwell gave us the theory that a beam of white light could be split up into three fundamental colors, namely: orange, green and violet. These are known as the primary light colors, and they continue to be universally used by color photographers in the form of light "filters" for the purpose of photographically separating and registering the three primary colors of the colored original onto the three separate negatives which are necessary for the production of a colored print. As a rule one of the three negatives contains the "red" values of the spectrum, another the "green" values and the third containing the "blue" values.

Quite early in the history of color photography the separation of the three primary colors was affected by placing liquid filters, either in front of the lens or behind the lens—within the camera. These liquid filters were flat plate glass cells, larger than the diameter of the lens. Prof. Vogel of Germany laid the foundation of the process which culminated in the far more practical dry filters and who gave us the dyes which permit us to add to the light sensitivity of the photographic emulsion also color sensitivity.

During the last ten years a great deal of progress has been made in the art of color photography. A very important development was the so-called "panchromatic" negative which greatly simplifies the production of the negative which contains the red values. Another important development was the "selective" sensitization of negatives for the three primary colors which was developed by Wolff-Heide of Berlin. His principle which permits the incorporation of the color filters into the photographic emulsion has brought about some very important changes in the present art of color photography.

The known methods for the production of color motion pictures may be classified under two main groups: viz., the "Additive" methods and the "Subtractive" methods. The store of accumulated knowledge and experience in each of the two groups is vast.

The "Additive" principle is the older and simpler of the two methods. Its most notable exponents among hundreds of research workers were: Prof. Miethe of Germany, Gaumont of France, Urban & Smith, Friese-Green of England, Berthon (Keller-Dorian) of France, Wolff-Heide of Germany, Elvey (Raycol) of England, Horst of Germany and many others each of whom has had some more or less new idea to further this principle.

The "additive" method in most cases prescribes certain changes in or additions to the projecting apparatus and camera and may be divided into three main sub-divisions:

a. The rotating color disc methods,

b. The multi-lens optical systems,

c. The lenticular methods.

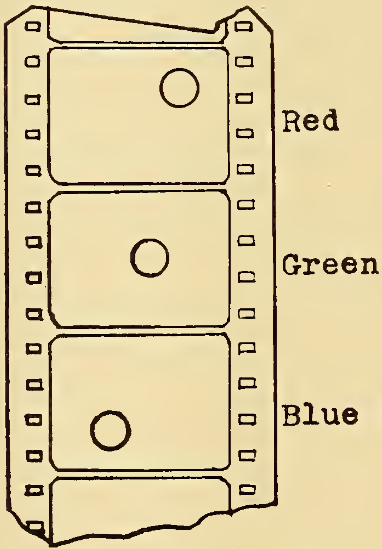


Figure 2

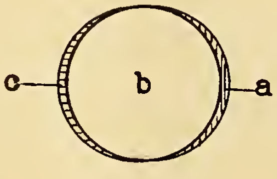


Figure 2-A

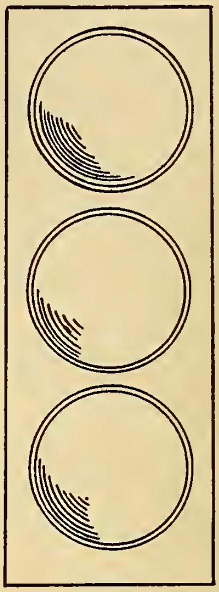


Figure 3

The Rotating Color Disc Methods are those in which the colored image is completed by the blending of differently colored images projected in rapid succession through the rotating color disc attached to the projecting apparatus. As a rule the disc contains the three primary colors: red, green and blue in various combinations.

In this method the red, green and blue image are arranged one after another on the film, making the film three times as long as a similar black and white film would be. Fig. 1. Since the three primary colors are "timely separated," even at the greatest film speed to which a projector may safely be put, no flickerless blending of the colors can be attained because of the fact that it is very difficult to mix red, a warm color with green and blue, two cold colors.

Many thousands of color schemes have been tried to produce a color disc which would permit a flickerless projection of colored films after this process and all efforts have failed to accomplish the desired results. Besides the color flicker this method also suffers from another serious shortcoming, the "color-fringing" called after Prof. Miethe of Berlin, "Parallax" (lack of registry).

The color fringing is due to the following fact: The timely separated three images: red, green and blue (Fig. 1.) projected onto the screen with great speed to make a colored picture could not be brought to a perfect registry. For instance: A white ball traveling at a reasonable speed would be photographed in the red picture image in the position marked (a), in the green picture image it

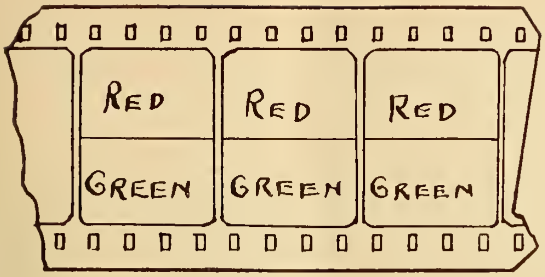


Figure 3-A

would reach the position marked (b) and in the blue picture image it would take the position marked (c) of Fig. 2. In the projection of these three images which have to be brought into perfect registry, which however is not accomplished as will be seen from Fig. 2a., which shows that the white ball, owing to lack of perfect registry became a three colored ball. The section of the ball marked (a) appears on the screen as red, the section marked (b) appears green and the section marked (c) turned blue. In the case of a white ball this change in color may be nothing serious or grotesque. But if the object photographed pictures a scene with a person, an automobile, animals and so forth, the result is far from satisfactory. The chances are, that a horse photographed would have a red head, green body and blue tail. The aforesaid technical shortcomings of color flicker and color fringes coupled with the fact that the process required three times as much film as a similar black and white production doomed it to failure from a commercial point of view. Urban & Smith's Kinemacolor and Friese-Green's processes are the best known examples of this particular method of the "additive" principle.

The next step in the attempt to perfect the "additive" principle was by way of two, three or four lens optical systems.

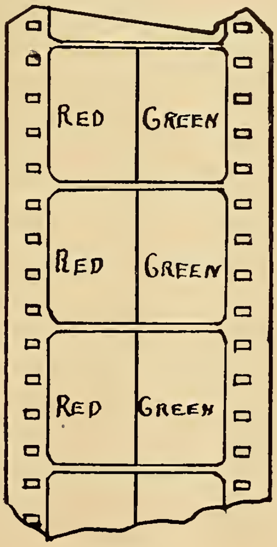


Figure 4

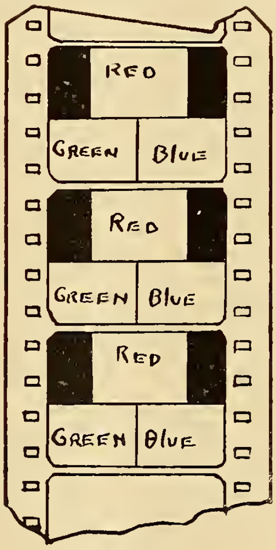


Figure 5

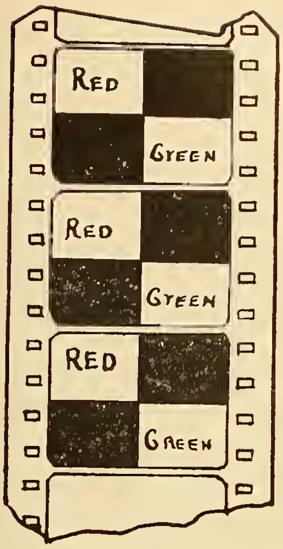


Figure 6

Multi-lens Optical Systems. Gaumont in France attempted to use a system of three lenses for the projection of the three coolred partial images: red, green and blue, simultaneously, and thereby hoped to eliminate the color flicker and color fringes. His lenses were arranged in accordance with Fig. 3. The theory of the plan was sound. Practice, however, as is so often the case, played havoc with a perfectly good theory. The first difficulty that arose was the bringing of the three lenses into a perfect focal registry. With more or less difficulty this was finally accomplished. The first few hundred feet of film projected through this elaborate optical system were remarkably perfect in color and definition. The vibration of the projector, however, caused by the terrific force required for the moving of the three partial images in place of only one image soon seriously interfered with the perfect registry and dislocated the position of the three lenses so that the registry of the three images ceased and the resulting color fringes were even worse than in the rotating color disc methods. This method also having been tried, tested and discarded. Inventive genius now attempted to solve the problem by dividing the normal 35 mm. picture image into two, three or four sections and to incorporate two, three or four lenses into the size of a black and white projecting lense. Busch in Germany, Pillny in Switzerland, Elvey in London, Horst in Germany and Jan Sczepanik in Poland were the most noteworthy research workers in this particular field. Busch for instance divided his image as shown in Fig. 3a. and runs his film horizontally. Pillny divided his image in the manner shown in Fig. 4. Elvey uses still another method of dividing his image as shown in Fig. 6. While Horst divided his image into three sections as illustrated in Fig. 5. In other cases the image was divided into four sections as Fig. 7. illustrates. The idea of dividing the image into two, three or four sections, in itself is, theoretically, not a bad one and does away with the color flicker very satisfactorily but could not solve the problem of registry any more than the Gaumont plan did. This plan did, however, increase the problem with a new one: definition and light. My readers who spend a great deal of time in a theatrical projection booth, realize almost daily how difficult it is for a film printing laboratory to obtain a normal black and white print in which the silver grain of a 35 mm. picture is reasonably invisible after the image is magnified approximately 400 to 1 depending upon the size of the screen of the theatre. By dividing the picture image into two, three or even four sections the partial image is reduced to a size of 17 mm., 11 mm. or to 8 mm., depending on the division. In the prejection of a film of this type the magnification is at the rate of 800, 1200 or 1600 to 1. The amount of light such projection requires, the resultant loss of definition and the visibility of the silver grain

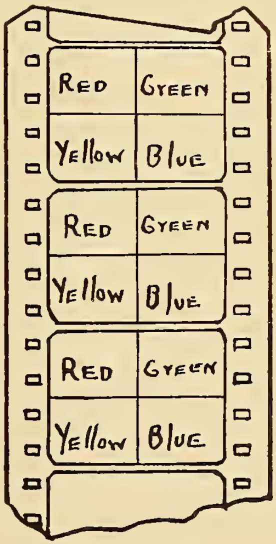


Figure 7

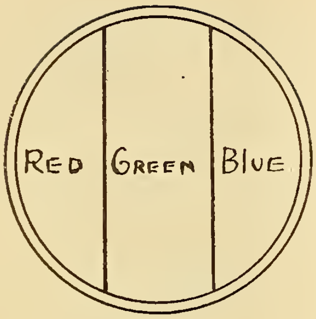


Figure 8

through this tremendous magnification gives us the effect of a picture taken through a microscope. But, entirely aside from the reasons just stated, the first and, in my opinion, insurmountable difficulty of getting an optical lens system which permits the adjustment of the lenses into a perfect and above everything else permanent registry, will defy every effort along these lines. In spite of the many research workers in this field, the most important of which is the large optical house of Busch in Berlin-Rathenau, Germany, no one has solved the problem of the optical lens system as yet. And, even if the problem could be solved, to what use will such process be put?

The professional field has troubles enough without the adoption of a complicated optical system and the amateur field would find such a process far too expensive and cumbersome, especially when a much simpler process, The Lenticular Method (Keller-Dorian) and (Kodacolor) is already available on the market. I like the theory of the lenticular process. This method, instead of using the plan of a multi-lens optical system uses a single lens but utilizes a great many microscopically small lenses embossed directly into the celluloid itself. These microscopically small lenses serve the purpose of registering the three partial color images: red, green and blue into position in the projection. In the projection of a film embossed to hold these microscopically small lenses a three color screen is attached to the projector which is divided as illustrated in Fig. 8.

The "Lenticular" method does away completely with the color flicker and color fringing and does reproduce practically all colors in a very satisfactory manner. Whether this process will ever find a wide adoption among the professionals and amateurs remains to be seen for it promises a number of problems to which a definite answer is not available at this writing. The most important problem is the one of light. The great number of microscopically small lenses and the color screen used (Fig. 8) absorb, in my estimation, approximately 75% of the light both ways, in the projection of the print. This is, in my opinion, the greatest of the problems confronting this process.

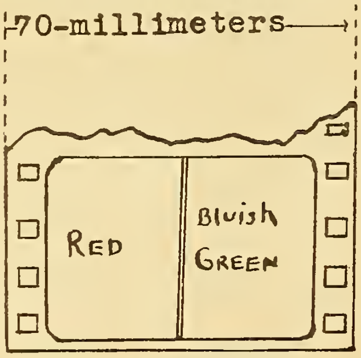


Figure 9

The next problem is the permanency of the embossing of the celluloid upon which depends not only the perfect registry of the three partial images but also the true color rendition. The tremendous amount of light required in the projection of this process creates so much heat that it is bound to affect the gelatine layer on the celluloid, if it won't bend the celluloid itself, and the dislocation of the gelatine by expansion due to the heat of the projector would result in a complete loss of the color values and registry.

We know, that the screen supplied for the projection of a 16 mm. Kodacolor film, a lenticular process, is a great deal smaller than the screen for the projection of a normal black and white 16 mm. film, and for this reason it is obvious to assume, that the size of the theatrical screen would have to be reduced in proportion and I have my grave doubts as to whether this can be done, especially in the large houses.

As a conclusion in connection with the description of the "additive" principle I say, that it hasn't produced a commercially feasible and satisfactory process so far and I doubt as to whether it ever will produce one in the future.

The "Subtractive" principle is comparatively new and attempts to render color without touching the projecting apparatus concentrating the work in the camera and the laboratory. While most of the "additive" methods are three color processes, practically all of the known "subtractive" processes on the market today are two color combinations. The greatest amount of research work in this field has been done by the Technicolor Organization which has done some very important pioneer work as a result of which its present "lithographic" process was developed.

In their manufacturing technique all of the subtractive processes are more or less alike. Each requires a special camera and special negative film or a bi-pack (two films held together) each requiring special printing and developing facilities, and for this reason the establishment of a motion picture plant for the handling of color films based upon the "subtractive" method requires several times the amount of money necessary for a black and white film plant of a similar scope.

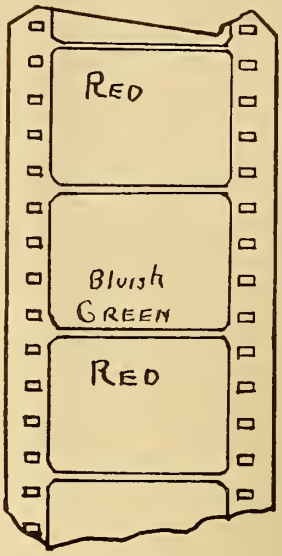


Figure 10

The average "subtractive" camera has one lens, behind which is a prism system. After a beam of light, containing an image of the scene which is being photographed, has passed through this lens it reaches the prism where it is divided into two separate images. These identical images are then passed through a bluish-green and orange-red filter which subtract like colors totally and their shades partially, depending on their spectroscopic analysis, and are then registered on two separate frames of the negative film placed behind the filters.

After the development of this negative two master negatives are made one containing all of the red impressions and the other containing the green-bluish impressions. These two master negatives are then printed upon a film coated on each side with a photographic emulsion. After the development of this positive print one side is toned in an orange-red color and the other side in a bluish-green color. As I have said before, there are many varieties of the subtractive principle which differ from each other only in insignificant details such as using a film that is twice as wide as the normal black and white negative film (Fig. 9.) or using a negative film on which the two partial images red and bluish-green are placed on top of each other as illustrated in Fig. 10, or using a bi-pack negative—a red sensitive film and a green sensitive film held together—with one process using a mordanting process for the coloration of the print while another

(Continued on page 30)

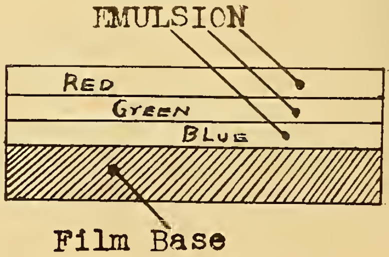
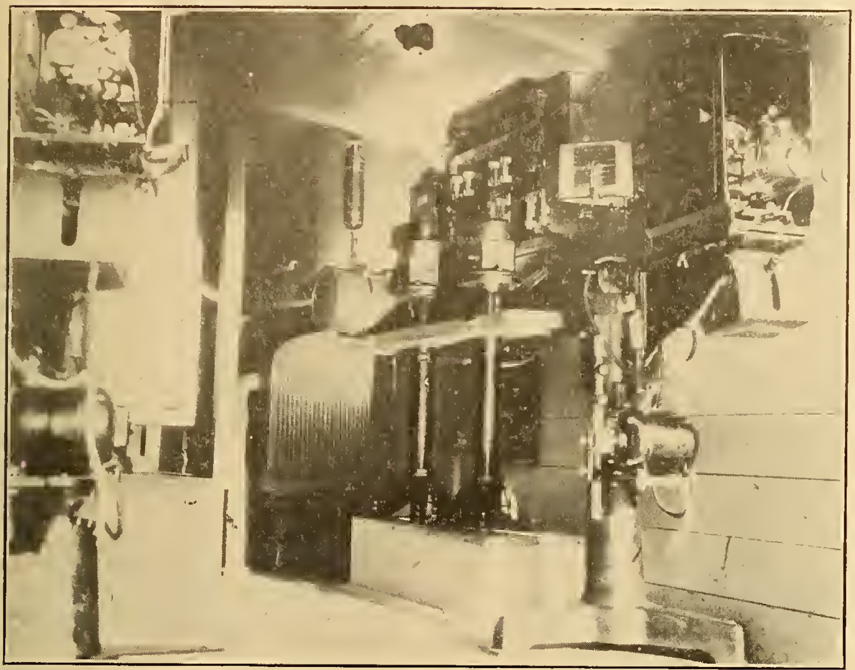


Figure 11

Projection in Remote South Africa

By JAMES H. DAVIE*



Interior of Truck Carrying Projection Equipment from Theatre to Theatre

EDITOR'S NOTE:—*Tons of paper have been used to describe the trials and tribulations of making a picture in the heart of Africa but nothing or, at best, very little has been mentioned about the traveling roadshow units with their small crew of pioneering Projectionists who bring the joy of modern science to people otherwise devoid of this medium of entertainment.*

THE first talking picture touring vans were made in South Africa. These vans were fully equipped with their own power plants, two projectors and complete sound equipment. They were designed to show talking pictures to the scattered population in the rural districts of South Africa. These villages or dorps as they are called in South Africa, are separated by many miles and connected together by poor dirt roads. In wet weather these roads become a hazard to safe traveling. Many of these dorps are without power supply. Some have direct current voltages varying 210V. to 250V., others have alternating current supply usually about 220V. and in many of these places the power is not switched on until after sundown.

Dorp Theatre

The theatre, if one exists, is an old frame building usually adjourning what one might call a tearoom or lunchroom. Sometimes it is owned by the hotel proprietor and usually equipped with an old time Kalee projector, a well worn generator and lamp house. In other places the town hall is used for bioscope purposes or, if no hall exists, the local hotel dining room is seated and used.

Truck Equipment

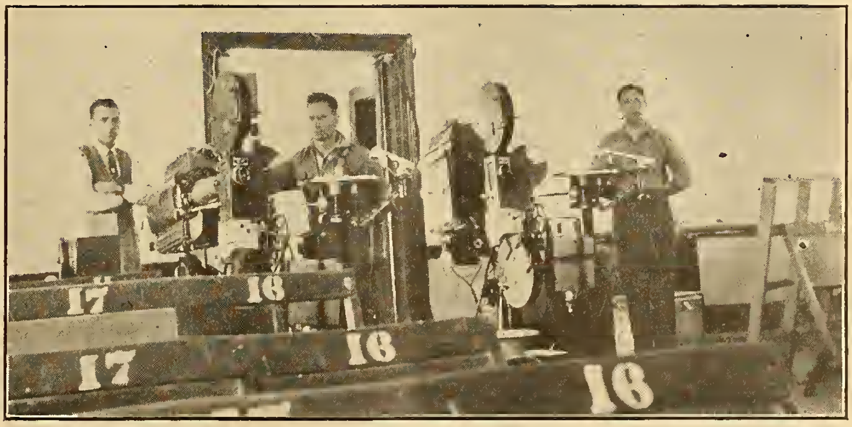
Because of all these various conditions throughout South Africa it was necessary for the vans to carry their own projectors and power plants. This consisted of two three point Simplex pedestals and mechanisms which were driven by underslung motors by means of a belt to the sound attachments. Two giraffe turntables were part of the equipment for showing disc pictures, driven from the projector mechanisms. The motors used for driving the projectors were 1/3 horsepower alternating current motors of the squirrel cage type. Interchangeable pulleys of various sizes made it possible to maintain proper projector speed where the municipality power supply was used and was not quite the proper frequency or voltage. In places where the van encountered direct current supply usually about 230V. a 3KVA rotary converter was used to obtain a 110V 50 cycle AC supply for the sound system and motors. If the power supply exceeded 230 volts a line resistance was used to break it down. Where no power supply was available this same rotary converter was driven mechanically by a belt from the four cylinder gasoline engine or 9 horsepower. This universal set also included a 2.5 KVA direct current supply for the arc lamps of the projectors.

As it was always necessary to obtain a 110V. 50 cycle AC supply the vans were equipped with a 3 KVA transformer 2-1 ratio for breaking down the voltage where 220 V.A.C. could be obtained.

A switch and fuse panel mounted in the van controlled the incoming power supply to the rotary converter and transformer and the outgoing power to the projectors motors, arc lamps and talking picture system.

The main amplifier of the sound system remained in the van where it was mounted in a frame on springs in order to protect it against jarring on the rough roads. The preliminary amplifiers were placed in front of each projector in the booth, mounted on springs in iron frames.

The outputs of the two first stage amplifiers were fed thru a volume control—the fader—to the main amplifier in the van by a special woven steel covered cable, used in order to protect this sensitive imput from any pick up especially during wet weather. This cable plugged into the side of the van at a point directly behind the main amplifier. From this same plug board, cables supplied the am-



Ready for the Show. No Booth Was Available at This Theatre plified speech currents to the stage and booth speakers.

---

* Formerly Engineer of African Talking Pictures Co.

Power was supplied to the projectors, motors and arc lamps from a similar plug board on the opposite side of the van behind the power control panel of the van. Excitation to the stage speakers was also supplied from this same plug board.

A non-synchronized turntable was part of the van's equipment which provided music while the house was filling up and for the exit march.

The equipment was stored in three felt padded cabinets and a set of drawers for smaller parts. The larger cabinets were sectioned off to hold each piece of equipment snugly in its place so as to reduce the possibilities of damage in transit.

At least six pairs of lens were carried of various sizes in order to obtain a proper sized picture for each house, also a complete list of spare parts.

The Truck

The van chassis were Dodge three ton trucks with 144 inch wheel base. The length gave considerable floor space of 12′6″ by 6′1″ with head room of 6′ at center. Two large doors opened at the back and a front window opened into the driving compartment. Two doors at the floor level on the sides of the van were opened when the rotary converter or universal set were running in order to provide a circulation of air to keep these machines cool. All these openings were trimmed with felt at the joints in order to reduce the dust entering the van during transit.

Personal

Each van carried a managing operator and an assistant operator. A colored native boy helped in setting up and taking down of the equipment and kept the equipment as well as the van emaculately clean. The time for setting up usually took about 40 minutes, to an hour.

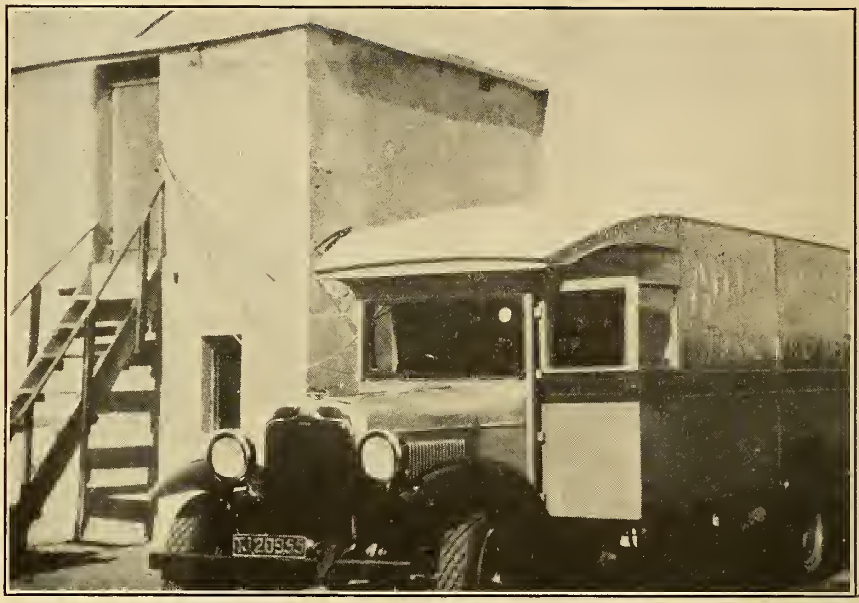
Precautions

Ground noises were completely overcome in this system by thoroughly grounding the armour covering of the imput wire and all the van's equipment was grounded to the chassis which in turn was grounded to the nearest earth when the van was in position alongside of the theatre.

Often accoustics of these theatres and halls were very bad. This was overcome in part by the proper placement of the speakers, reducing the size of the speaker baffle, or electrically by means of an adjustable line equalizer in the imput circuit of the main amplifier.

Obstacles

The experiences of these vans were varied and interesting and full of adventure, for example; fording swollen rivers, traveling for days lost, running out of gasoline and having to walk miles to a nearby farmer for aid;—or to find the power supply failing in the midst of a show and going down to the village power station nearby to find the colored native attendant had gone to sleep and the fire under the boiler suffering for the want of coal. It was a very common occurance for the vans to get stuck for hours until sufficient teams of oxen could be enlisted from farmers to pull them out, but with all these obstacles each of the eight vans established a reputation for keeping their play dates.


Wires Carry the Current from Generator in the Truck to the Equipment in the Booth

Claims Stereoscopic Pictures

A message from Johannesburg, South Africa, claims that Dr. R. T. A. Innes has invented a system of stereoscopy. Dr. Innes was formerly South African Union astronomer, so that any claim he makes has more than usual scientific interest. The invention is founded on a special optical appliance which is fitted near the screen. Changes in the methods of taking pictures will, it is claimed, not be necessary. Details of the invention have not yet been revealed.

For Fire Only

Fire extinguishers are placed in the projection room for emergency use only. The most common type of extinguisher used is of the Carbon Tetrachloride solution.

Carbon Tetrachloride has the ability of an oil solvent and consequently it serves the purpose in a great many booths for cleaning parts of the equipment upon which oil has collected.

Clean equipment coupled with a clean booth constitutes ideal working conditions and better projection, *but* under no conditions should the contents of a FIRE EXTINGUISHER of the tetrachloride type be used for such purposes. The extinguisher must be reserved for emergency. Film fires can and do occur at the most unexpected times no matter how efficient the crew.

Fire extinguishers must be maintained in loaded condition and should be tested periodically to determine their ability to function properly.

Carbon Tetrachloride also has the power to dissolve rubber, therefore extreme care must be exercised when using it to remove oil around equipment that has rubber mounting pads and above all, wires that have no cotton or other protecting sheath around them.

At Columbus

Among those represented at the exhibition of projection room equipment at the recent Columbus convention was the McAuley Company of Chicago, manufacturers of the Peerless projection lamps.

Mr. Donald McCray, McAuley's representative, was an attendant at the convention throughout its entire period and established personal contact with hosts of delegates.

The exhibits, although few in number, were high spots of the convention and indicated possibilities at future conventions.

Dynamo Troubles and Cures

By P. E. Chapman*

IT is, of course, impossible for the projectionist to make any serious repairs to his motor and generator equipment, such as rewinding, making new bearings, turning commutators, etc., but there are a lot of "mystery dispellers" that every projectionist should know.

Direct current (D.C.) motor and dynamo equipment always give the most trouble and require the most care. A major part of these troubles centers around the commutator and brushes.

One can learn to read the condition of a D.C. machine from the appearance of the commutator and the brush behavior just as a physician reads the tongue of his patient. The following items will help the projectionist to read these symptoms:

Commutators are usually made up of copper sections or bars which in the better class of apparatus are insulated with mica.

With the exception of the Universal type of small motors, the commutators and brushes should run almost free from sparks. This is particularly true of those around the projection room as the sound apparatus is likely to pick up the "static" radiated from these sparks and send it out into the theatre.

Brushes

The appearance of a commutator in good condition will vary with the kind of brushes used on the machine. There are a number of kinds of brushes used on commutators at the present day and the kind will influence the appearance of the commutator after use.

Briefly, brushes may be made of a combination of several things, such as ordinary carbon, (seldom used as it requires continued lubrication applied by hand); or a mixture of carbon and graphite (frequently used), or they may be made of graphite, of which there are many forms. Synthetic graphite looks a lot like carbon, and there are many forms of natural graphite, stove polish being most commonly known.

Various mixtures of graphite and metal are used for brushes. Except in his automobile, the projectionist seldom encounters this type.

Where brushes are made of carbon without or with a little graphite, the mica of the commutator is usually run flush with the copper. These brushes are very slightly abrasive and wear the mica down with the copper. The mica must, however, be a soft mica, usually known as amber mica.

If, however, the mica is hard, as India mica, or the brush too soft, then the mica does not wear down as fast as the copper and sparking results. This condition is called "high mica" and the "high" may start at a height of .0001. These sparks are usually blanketed by the brush at first for they occur on the FACE of the brush (largely). This trouble will show up after the machine has run anywhere from a few hours to a year, usually in about two weeks to a month.

The copper of the commutator will assume a dusty black appearance, will run hot, may throw the solder out of the joints between the commutator and the winding, and eventually make a lot of trouble. When it first appears it can be temporarily relieved by sand papering the commutator with about No. 1 or No. 1½ sand paper. If this is the cause, however, the sanding will afford only temporary relief. The trouble will reappear shortly. The remedy is to get the right brush composition for that machine or undercut the commutator.

Many machines, particularly the A.C. commutator types, will run efficiently with one particular composition or type of brush (called "grade" of brush) and will give endless trouble with other types of brushes. This is one of the reasons why many manufacturers put plates on their machines giving the catalog number of the brushes to be used with their particular machines. Some of the carbon brush companies have lengthy lists of the correct brushes to use with each machine.

When the brush is of a softer texture, as graphite, it may run without lubrication; but such brushes will not run on a commutator that has the mica flush with its surface. Therefore it is necessary to cut, or groove, the mica down a short distance, between the segments of the commutator. This is called undercutting.

Undercut commutators must have the dirt cleaned out of the undercutting occasionally or short circuits will develop. They should not be lubricated, as a rule, although some of them *must* be lubricated and cleaned often. Flush mica commutators will usually require lubrication with a little vaseline every few hours but do not have to be cleaned out.

When commutators, using carbon brushes, are working efficiently they will assume a brown glaze. If using graphite brushes they will still be somewhat glazed but more or less black. This black is not the dusty black caused by "high mica." If the commutator shows *bright* copper color, it is cutting, either from lack of lubrication, flecks of copper stuck on the face of the brush, wrong brush composition, or either causes. To start the cure, first remove any bits of copper from the face of the brush. Sand paper the bright zone on the commutator, then lubricate, preferably with vaseline. If vaseline is not available use a little mineral oil from the bearings.

Sparking

There is one kind of a spark on commutators that the projectionist always wants to be on the lookout for, particularly on undercut commutators. It is innocent looking and likely to be ignored. It is a *dull red* spark, like the end of a lighted cigar, traveling around the commutator. It travels first at irregular intervals, then more and more frequently and more persistently. This is the real danger signal, but it is so quiet and insidious that it usually is not noticed until it burns out the armature.

This spark is the real, genuine and original warning of an armature about to burn out. Don't ignore it!

What is happening is that the mica between two commutator sections has broken down, or the undercutting filled up with dirt and the current is short circuiting across the mica. This will burn out a section or two of the armature and the net result, as a rule, is that the whole armature will have to be rewound.

To correct this situation it is necessary to first clean out the undercutting, if it is an undercut commutator. Then look for burnt or soft spots in the mica between the commutator sections. If the mica is good, scraping it will show white and hard. If you have found the bad spot, scraping will show either black or a dirty grey and soft surface. If you have caught the trouble at its inception, the burnt spot will be shallow and after cleaning may be ignored. If the spot is more than 1/32" deep, it should be filled with one of the commutator repairing compounds. It would be well to call in the local motor repair man as these compounds are rather tricky and should be put in by an experienced man.

If the burn is very deep the assistance of an expert repair man is almost compulsory.

Long, thin, snappy sparks, jumping off from the brushes and sometimes running around the commutator, mean that there is an open circuit in the windings. Call in your repair man at once or you will ruin your commutator and *burn out your armature.*

Bearings and Air Gaps

The air gap of a motor is the space between the rotor and the stator, or field. This air gap is not, as it might seem, only just a "frictionless" joint in the magnetic circuit of the motor or generator. It is very important and should be kept uniform. This is done, of course, by the bearings.

---

* P. E. Chapman Electrical Works, St. Louis, Mo.

In D.C. machines the first disturbance due to irregular air gap is likely to be sparking at the commutator, for an excess sparking will occur, as a rule, long before the armature actually rubs the field.

In all machines, rubbing of the fields because the bearings are worn, will cause heating of the machine and may cause severe damage to the windings. So occasionally inspect the air gaps of your motors and dynamos.

The air gaps of D.C. machines vary with the size of the machine. The motors and generators around the projection room will usually be from 1/32" to 3/32".

The bearings should be renewed if the gaps are off as much as 50% of their normal length.

The air gaps of most of the A.C. motors the projectionist will encounter will be very nearly .018" long, sometimes a little less and rarely more than .020". One will readily see that a mighty small amount of wear in the bearings of such a motor will cause the rotor to rub. If the bearing is worn over size as much as .006" the rotors of most A.C. motors will rub due to the fact that there are tremendous magnetic pulls in the machine which are neutralized only if the air gap is uniform. If it is not, then the magnetic pulls on the near side become enormous and on the far side decrease rapidly. With such small air gaps the lack of balance will become so great that it will spring the shaft and motor frame enough to cause the rotors to rub the stators. This brings other evils in its train.

From this it will be seen that a very small wear in the bearings will cause the rotor to rub although the air gap seems to have plenty of margin when the motor is stationary. Such rubbing is usually first marked by an unusual racket or rumpus during the starting, for the rubbing first occurs during starting.

Polyphase Motors Burnouts From Overload Are Seldom Encountered

The commonest cause of burnouts in polyphase motors is single phasing. Single phasing occurs when one leg, or wire, of a polyphase circuit is opened. A burnout from single phasing will be in spots uniformly spaced around the winding.

Single phasing can be detected by a marked change in the normal singing or hum of the motor *while running*. It may change its timbre or tone quality but will be *sure* to increase in intensity.

If the operator notices this change in time nearly all burnouts from this cause may be prevented.

If the circuit is single phased at starting, the motor will hum but will *not* start. If given a start by any other means it *may* but not necessarily will come up to speed. The increased hum will then be apparent as described above.

Owing to the prevalence of two sets of fuses (starting and running) and of starting devices that may be defective, the fact that the motor *starts* is no proof that it is not *running* single phase.

The usual cause of single phasing is the so-called "running fuse," which is a fuse whose capacity is near the full load current of the motor in circuit with it.

Therefore the worst enemy or menace a polyphase motor has is the so-called "running fuse" or for that matter any other single pole disconnecting device. The nearer its capacity is to the motor rating, the greater menace it is to the motor, as one of them will blow more frequently. The usual cause of blowing a close or running fuse is a load, either momentary or sustained. A short circuit may blow two fuses at the same instant, but this hardly ever occurs with a load. Therefore, part of the motor windings are still in circuit-single phase.

When single phasing occurs, the H.P. capacity of a polyphase motor drops to about half its rating, the running or load carrying current increases in the one phase. However, the maximum current it would safely carry per leg (three phase) drops and its locked current (that is, the maximum current standing still) drops. It is seldom that the single phase load or locked current will blow the remaining running fuse or fuses.

If the motor be standing still it will not start, and unless disconnected will burn out promptly. If it be running when single phasing occurs, and carrying half load or less, it will continue to run without damage because half loads do not blow normal fuses. If it be running on a full or over load, when single phasing occurs, it will try to keep on running, throwing all the work on part of the windings, which sooner or later burn out. If the load be too heavy, it stops the motor, and as it cannot then re-start nor blow the remaining fuse, the burnout is prompt.

A polyphase motor, if given plenty of current (large fuses) will take care of itself in ordinary mishaps, such as interrupted power, or severe temporary overload; but if it be closely (running) fused, it may single phase and burn out. It is particularly true on polyphase motors that fuse (or circuit breaker) cannot protect it against internal mishaps; therefore, on polyphase motors, the fuses should be used to protect the *line*, or wiring to the motor, against catastrophies, such as burntout motors, or other causes of dead shorts. Hence the fuse size should be as large as the wiring to the motor will permit.

Fuse Capacity

The running fuse sizes given in contemporary tables are too small, and therefore a menace to polyphase motors. They should be eliminated, or if an over zealous inspection department insist that running fuses must be used, they should be at least 2½ times the rating of the motor or more. The most satisfactory running fuses, or those that will do the least damage, are the so-called "starting" fuses of these same tables, although they are possibly a little large.

A three phase motor fused with two fuses only (third leg solid copper) is much safer than one with three fuses. This is rapidly becoming standard practice.

Delayed-action, multipolar circuit breakers with at least two actuating members are the best protection for polyphase motors. They do not cause single phasing. They will permit momentarily heavy currents such as occur at starting the motor or at its load and remain open on a sustained or damaging overload.

Testing

To locate the open leg is confusing. Possibly the best method is to momentarily open each leg in succession, noting the effect on the behavior of the motor. Opening the already open leg will, of course, cause no change in the behavior of the motor and gives a positive answer.

Another method is to branch a test lamp across the terminals of the line and then of the motor. If the line is normal, the test lamp will burn with equal brilliancy across each leg of a three phase circuit. If a three phase motor is running single phase it will be found that a test lamp placed across the phases will burn normal on *one* leg and will be dimmer across the other two. The wire that shows the dim lamp to *both* the other two wires is the open wire. This test is confusing in that the test lamp will burn from the *open* wire to either of the other two. What should be noted is that it will not be so bright.

On two phase 4-wire systems the lamp will burn brightly across the good phase and only slightly less brightly across the open one. On two phase 3-wire systems better try opening the circuit, as the lamp test is very confusing.

Rotors

Rotors of polyphase motors do not "burn out" but sometimes are afflicted with open circuits.

"Open circuited" rotors are indicated by the lack of ability to carry the normal load. But the most outstanding thing is the noise made by such a rotor. It will sound like a pair of "bum" cast gears with a few teeth out!

It is noted that most polyphase and many single phase rotor "windings"

(Continued on page 33)

Is It Really *Noiseless* Recording?

By J. Kenneth Hiler

This article begins a new monthly feature by Mr. Hiler. Each month the questions received by Mr. Hiler will be answered by him in full and comprehensive form. Readers are at liberty to use this service in such a manner as will be of advantage.

Questions should be as descriptive as possible and must contain all the necessary information relating to the situation. This is necessary if a fully comprehensible answer is desired.

Question:—Can you tell me why I cannot notice any apparent differences between the so called noiseless recording and the regular recording at my theatre. There seems to be background noise during silent scenes which is contrary to the information I have received relative to the noiseless recording.—Submitted by FREDERICK BRANT.

SINCE the adoption of the noiseless recording method at the major studios, much greater care must be taken to reduce the noise level of our reproducing equipments and to the elimination of foreign noises which are induced from outside sources.

Many good articles have been written on this subject, appearing in different publications. You have probably read some of them and it may be tiring to refer to it again, but unless we are reminded from time to time we become careless and unknowingly allow our audiences to listen to hums, frying noises, and sputtering sounds which are very unpleasant.

The Background We Do Not Hear

We become immune to these unpleasant sounds that accompany our program and unless we take pains to eliminate them our audiences will patronize other theatres or none at all. The din of our projectors, blowers, generators, etc., make it very difficult to make close observation and our ears become deadened after a few hours of this mechanical noise in our booth. A few minutes each day before putting our show on the screen should be spent listening to the output of our equipment. It will tell us a lot and may help us detect trouble which may develop into something serious in time if not corrected.

Electrical Ear

In fact our sound equipment working nearly wide open becames an extremely sensitive electrical ear which after experience can recognize or interpret the meaning of the various sounds and correct them before they become serious.

Tube Hiss

Each day before opening the house we should find time to turn our system on and listen to each projector idle and then running without film. When the projector is idle nothing but a hissing sound should be heard from the horns or monitoring head phones even with the fader at the highest point. This should entirely disappear when the exciting lamp is blocked off with a card, that is, the light passing through the optical system is prevented from entering the photo cell. If it doesn't, there is generally a gaseous amplifier tube or photo electric cell which can only be detected by this test. Such tubes should be removed from service unless it is found the amplifier tubes can be used satisfactorily in some other part of the system. This is not always good economy unless you are definitely sure the tubes so removed will not cause further trouble if used in other circuits.

Background Considered Normal

Nearly all systems have a slight background noise which is considered normal and not objectionable to the reproduction, but this background is practically inaudible with the system wide open. With the exciting lamp "off" as suggested above, very little difference should be noticed whether the fader be at zero or maximum. This would prove that the slight background audible with the fader at zero is coming from the amplifier racks, but if just audible with head phones it is probably normal. It is usually recognized in a slight hiss modulated by a low rumble.

Mechanical Vibration

Now with the exciting lamp still blocked off, start the projectors one at a time and listen, bringing the fader gradually up to maximum. This procedure is suggested for a protection against damaging the horn units or other parts in the event the amplifying equipment on the projector has developed trouble which might send a strong surge through the system.

At normal speed, a slight rumble or ringing sound might be heard varying in pitch until the projector reaches normal speed. This is due to mechanical vibration being transmitted to microphonic tubes in the P.E.C. amplifier. Unless some gear or bearing in the projector and drive mechanism is causing excessive vibration, the tubes should be replaced or changed around until a minimum noise level is reached. If it makes no difference in the noise level no matter how many tubes are changed, check the mechanical operation of the projector and drive, some gear or bearing may be binding. Sometimes the position of the cradle of the amplifier may have shifted due to changing projection angles. If the adjusting screws for changing the position of this P.E.C. amplifier are not readily accessible call in your sound engineer who is experienced with the equipment. The amplifiers are extremely delicate and care should be taken even in replacing tubes, not to jar it excessively.

Filament Vibration

Remove the card or whatever method was used to block off the exciting lamp. Check for good focus and start the machine again. Only the hiss first mentioned should appear. If a ringing sound is heard, varying in pitch until the projector reaches normal speed, adjust the exciting lamp while the machine is still running. You will generally find just a slight adjustment in any direction will eliminate the ring. However, the up and down is most critical. As this adjustment is made, two distinct points will be noticed that produce this ringing sound the loudest, and a point between these two on the up and down adjustment will be found to be very quiet, quite free from ringing or rumble. This point is where the lamp should be left, but a check should be made of the focus before threading up to make sure light is getting to the Photocell. The visual focus may not appear to be as good but the reproduction will not be affected and the ringing sound will have been minimized if not eliminated.

Sagged Filaments Produce Noise

The ringing noise is caused by the vibration of the exciting lamp filament. The filament is wound in a helical fashion and the ragged edges which cross the slit cause a varying light to strike the photo cell and thus causing the photo cell to reproduce the vibrations. Filaments that have sagged to any degree can not be adjusted to a point of no ringing unless the projector is exceptionally free from vibration. With a sagged filament no matter what adjustments are made. some part of the image of the filament will cross the slit in the optical assembly and produce trouble. Even if a ribbon filament lamp is used, a similar trouble is experienced but not as pronounced due to stronger mechanical structure. If the edge of the image, even if not ragged, crosses the

(Continued on page 33)

The Function and Design of Filter Circuits

BY W. A. HARGRAVE

Probably in the minds of persons not entirely familiar with the engineering principles involved in filter circuits there is considerable mystification as to why it is that in the process of sound reproduction an engineer can, so to speak, "make a canary sing bass." Filter circuits are used for many purposes other than tone control, and in his series of articles beginning in this issue Mr. Hargrave considers these various applications and the method required in fitting the filter to its specific purpose. The author is an electrical engineer and a member of the Photophone Division of the RCA Victory Company.—THE EDITOR.

Part I.

IN many respects, filter circuits, although the most employed devices in amplifiers and associated equipment, are not generally well understood. The purpose of these articles is to present the problems of filter design and filter applications in a manner sufficiently clear to give the reader a fair knowledge of the most general filter circuits as well as provide sufficient information to enable him to work out many of his own filter problems.

Subdivisions of Filters

Electrical filter circuits play a most important part in the operation of the radio sets, the telephone systems, sound motion picture recording and reproducing equipments, and the many other allied devices in this field. The filter employed may be classed in accordance with the use made of it in a particular circuit, such as smoothing or ripple filters, audio filters, timing circuits.

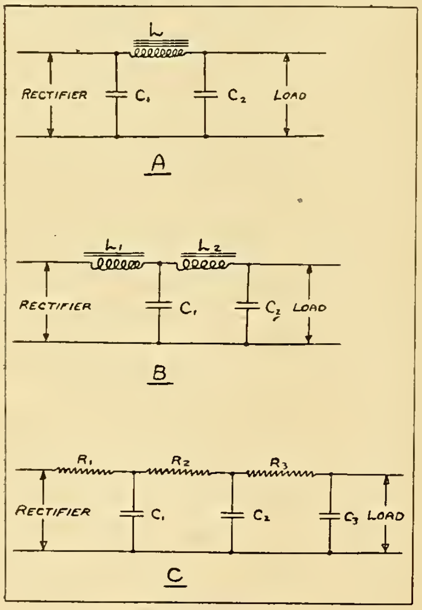


Fig. 1. Typical Ripple Filters

This classification of filters is a general one. The audio filter, as an example, may be subdivided into the following types: High-pass filter, low-pass filter, band-pass filter, band-elimination filter.

The ripple filter, which is a special case of the low-pass filter, shall be of concern to us here. Typical ripple filters are shown in Figure 1. As shown in this figure the ripple filter may either consist of a combination of inductances and capacitors, or a system of resistors and capacitors. The resistance filter may be effectively employed wherever the current drawn from the system is small. Its chief advantages are in its low cost, unsusceptibility to pickup, and the ease of obtaining units of close tolerances.

The most common application of the ripple filter is for smoothing or filtering out the ripple voltage from a rectifier or motor generator set so that a direct current voltage may be obtained sufficiently free from ripple or hum voltage for supplying power to the plates of a power stage, a complete amplifier system, an exciter lamp, or loudspeaker field.

The voltage supplied by the rectifier is a pulsating direct current voltage as shown under A of Figure 2, or it may be thought of as divided into two components, one a steady direct current under B and an alternating current as shown under C. In the full wave rectifier the frequency of this ripple voltage will be twice the frequency of the power supply, and the same frequency as the power supply when a single sided or half wave rectifier is employed.

Filter Design

Let us take up the actual design of a filter for an "AC" operated (from a 120 volt 60 cycle power supply) power amplifier. Since our problem is concerned with the filter, we shall only consider the characteristics of the rectifier supply and the power stage which have a direct bearing upon the design of the filter. Our original assumptions and the approximate size of the filter reactor and capacitors to be employed will depend upon the power which must be supplied for the power tube or tubes.

If the voltage is high and the current low, the lowest cost combination will require larger reactors and smaller capacitors than in the case where the voltage is low and the current large. If the voltage is low enough we may take advantage of the electrolytic capacitor with its inherent characteristics of large capacity and small size. In any case, care must be exercised to ensure that the capacitor used has a sufficient voltage rating to care for the greatest voltage subjected to it during the normal operation of the amplifier. The voltage applied across the capacitor will be approximately the sum of the peak ripple voltage and the steady component of the direct current voltage (see Figure 2). The voltage rating of the capacitor should be slightly in excess of the maximum voltage delivered by the rectifier with the maximum line voltage likely to be encountered.

Whether our filter shall be of the general types shown under A or B of Figure 1 will depend upon the tubes used in the rectifier. If the rectifier tube is of the vacuum type it is usually most practical to employ a single stage filter with the capacitor connected directly across the rectifier output. However, should the rectifier tube be of the mercury vapor type, a reactor should, in most cases, be connected between the first capacitor and the output of the rectifier to ensure satisfactory operation and life of the rectifier tubes (see Figure 1B.)

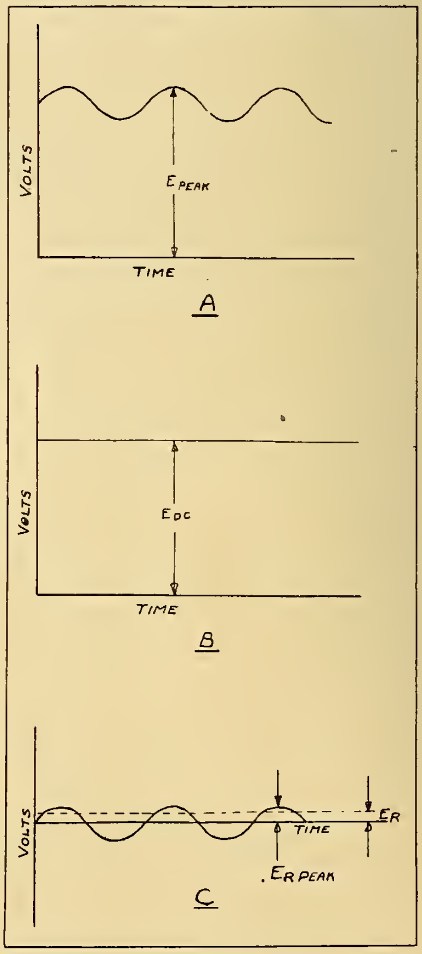


Fig. 2. Character of Voltage Supplied by Rectifier

Since the use of the circuit of Figure 1A will give a greater voltage output from the rectifier for a given plate voltage, let us assume that the rectifier for which we are designing a filter, employs vacuum tube rectifiers connected for full-wave operation. The ripple frequency will be 120 cycles. Let the ripple voltage be represented by Er1. This voltage will be impressed across the first capacitor C1 shown in Figure 3. Although the first capacitor does not effect the filtering of the circuit as employed here, it does effect the ripple voltage from the rectifier. An increase in the capacity of C1 will reduce the ripple voltage of the rectifier. Also, an increase in the capacity of C1 will produce an increase in the total rectified voltage. From Figure 3 it may be seen that the ripple voltage Er1 is also impressed across the series combination of L and C2. We are interested in reducing the part of the ripple voltage Er1 across C2 to a value low enough to ensure very low hum output from the power stage.

The ripple voltage Er2 across C2 will depend upon the impedances of L and C2. We may express this division of the ripple voltage, or the filtering obtained from this single stage filter as the ratio of the impedance of C2 to the sum of the impedances of C2 and L. Since the impedance of C2 is usually very small in comparison to the impedance of L, the addition of its impedance to that of L will effect the impedance of L by only a very small amount. We may, therefore, express the effectiveness of our filter by the ratio of the impedance of C2 to the impedance of L. From this, it follows that the ripple voltage Er2 will equal Er1 multiplied by the ratio of Xc/Xl, where Xc equals the impedance of C2, and Xl the impedance of L.

Conditions and Valves

For our problem let us use a value for Er1 of 75 volts, and a value of permissible ripple for Er2 of 1.5 volts. The current which we are required to filter is 0.150 amperes at 530 volts. A reactor having an inductance of about 25 henries and a resistance of about 350 ohms is a reasonable choice. With this reactor the size of the capacitor required to reduce the rectifier ripple voltage Er1 from 75 volts to 1.5 volts may be determined by the use of the equation given above for Er1. Solving for Xc in the equation

$$Er2=\frac{Er1 \times Xc}{Xl}$$

Solving this equation for Xc, we have

$$Xc=\frac{Xl \times Er2}{Er1}$$

We know that

$$Xc=\frac{1}{6.28fC2}$$

$$Xl=6.28fL$$

where

$f=120$ cycles

$L=25$ henries

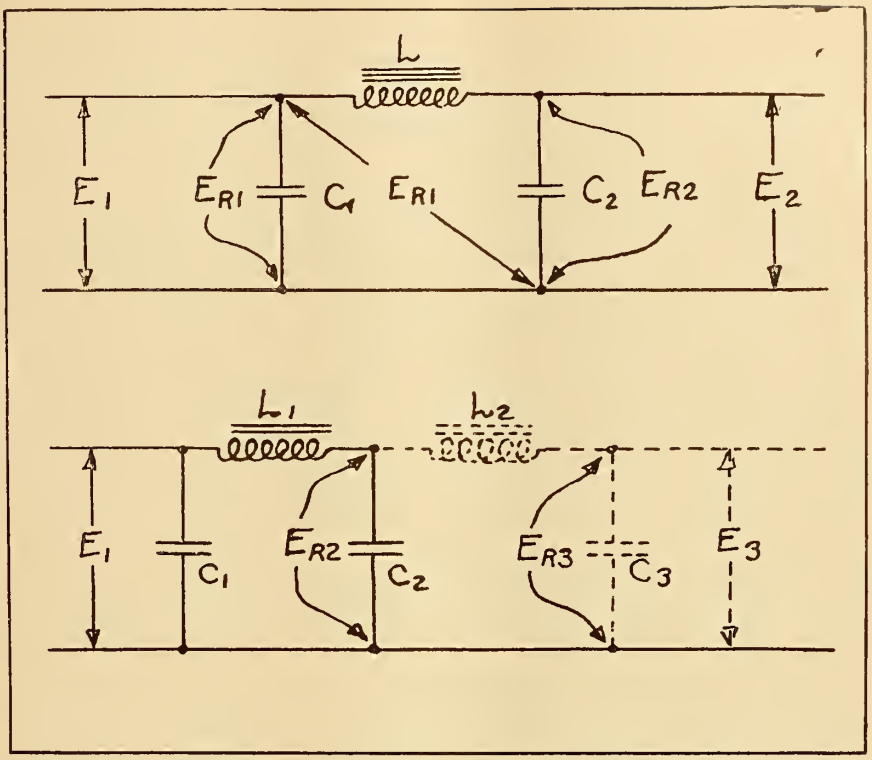


Fig. 3. (Upper) Fig. 4. (Lower) Capacitance = Inductance Filters

C to be determined by the following calculations

$$Xc=\frac{Er2 \times Xl}{Er1}=\frac{1.5 \times 18850}{75}=377 \text{ ohms}$$

$$C2=\frac{1}{6.28fXc}=\frac{1}{6.28 \times 120 \times 377}=3.5 \text{ microfarads}$$

The design of rectifiers to supply the load required here has shown the size of the first capacitor for the best results should be three or four microfarads. We shall, therefore, use the same value of capacity for C1 as determined for C2.

Power Strange Requirements

Now since the power stage requires 530 volts direct current for its operation, capacitor C2 should have a rating for at least 600 volts direct current.

The voltage drop in the filter reactor is equal to the resistance of the reactor multiplied by the current carried by the reactor, that is, 350x0.150 or 52.5 volts.

Then the total direct current voltage impressed across the capacitor C1 is 530 volts plus 52.5 volts or 582.5 volts. Referring to Figure 2 we see that the 75 volts ripple is a root mean square value equal to about seven-tenths of the value of the *peak* ripple voltage. To rate the capacitor safely we should add the peak ripple voltage to the total direct current voltage.

From the above, we may obtain the peak value of this voltage by dividing the 75 volts by 0.7, giving 107 volts peak ripple across C1. Then the maximum voltage across C1 is 107 volts plus 582.5 volts or 689.5 volts. Thus the safe rating for the capacitor should be about 800 volts. These voltage ratings are only approximate, for we have not considered the regulation of the power transformer, rectifier, the filter, nor the nature of the load. We have not considered these factors here as they shall be covered in the discussion on the design of a rectifier.

Ripple Voltage Reduction

Should it be desired to reduce the ripple voltage to a much smaller value than done with the single stage filter, a second stage may be added as shown in Figure 4. Since the impedance of the added section will be very high compared to the impedance of C2, the value of Er2 of the above problem will not, for our purpose, be changed by the additional stage. In the same way in which the ripple voltage across C1 was reduced to a much lower value across C2, so will Er2 be reduced by the added stage giving a much lower ripple voltage Er3 across C3. The calculations for the second stage will be performed in the same manner as for the first stage. The equation for the second stage is

$$Er3=\frac{Er2 \times Xc3}{Xl2}$$

solving for the impedance of the capacitor C3

$$Xc3=\frac{Er3 \times Xl2}{Er2} \text{ ohms}$$

and solving for the value of reactor impedance we have the equation

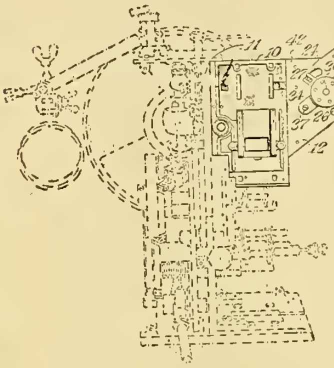
$$Xl2=\frac{Er2 \times Xc3}{Er3} \text{ ohms}$$

The treatment for resistance filtering Figure 1C may be done in the same manner employed for the capacitance-inductance filtering Figures 1A, 1B, 3, and 4.

RECENT PATENTS

This page is conducted by Mr. Ray B. Whitman, Patent Attorney, 277 Park Avenue, New York City. Copies of any of the patents cited may be obtained by addressing the "Patent Editor," this magazine.

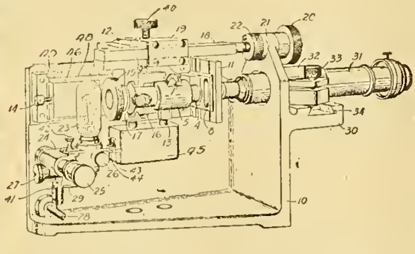
1,863,366. ADJUSTABLE APERTURE FOR MOTION PICTURE PROJECTION MACHINES. AUGUSTO DINA, Jersey City, N. J., assignor to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed Nov. 30, 1928. Serial No. 322,702. 2 Claims. (Cl 88—17.)



1. A motion picture machine having a film aperture, a frame adjacent thereto, said machine and frame having aligned passages, a pair of apertured slidable plates disposed in said frame and movable in said passages with regard to said film aperture, a rotatable knob on said frame, arms extending oppositely from said knob and having slots therein, and pins on the plates adapted to project into the respective slots whereby the turning of the knob will slide the plates in opposite directions.

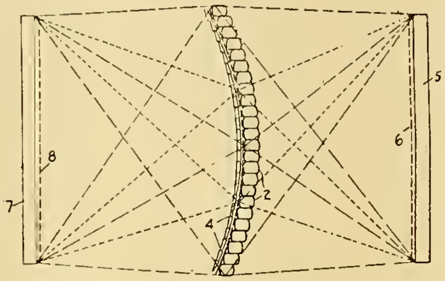
◆

1,863,384. LENS TUBE ADJUSTING APPLIANCE. ROY V. TERRY, Montclair, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a Corporation of New York. Filed Aug. 27, 1929. Serial No. 388,673. 9 Claims. (Cl. 88—1.)



1. In combination a source of light, a support having a main portion and an apertured extension, said extension forming a surface simulating the surface of a film sound record, an optical system mounted on said support and illuminated by said light to form an image in said aperture, and appliance for adjusting said optical system comprising a member having mutually normal flat surfaces formed so as not to obstruct said image, means for retaining said support in contact with said mutually normal surfaces mounted on said member, and manually operable means mounted on said member and engaging said optical system to vary said image.

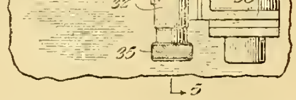
1,862,847. METHOD OF MAKING STEREOSCOPIC PICTURES. ERNEST E. DRAPER, Scarsdale, N. Y., assignor to The Perser Corporation, New York, N. Y. A Corporation of New York. Filed Aug. 8, 1930. Serial No. 473,930. 3 Claims. (Cl. 88—24.)



1. The method of printing stereoscopic positives from relief negatives, which consists of projecting the image through a multiplicity of lenses arranged on the arc of a circle, adjacent prisms and a screen located between said negative and said lenses, on to a sensitized plate placed slightly behind another similar screen, both of said screens being formed of alternate opaque and transparent vertical lines.

◆

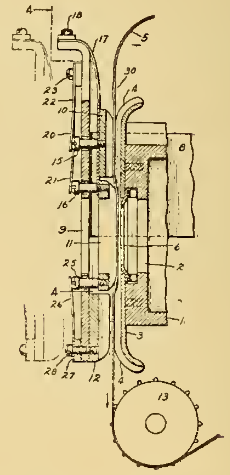
1,863,300. SUPPORT AND ADJUSTMENT FOR SPEAKING MOVIE EXCITER LAMPS. AUGUSTO DINA, Elizabeth, N. J., assignor to International Projector Corporation, New York, N. Y., a Corporation of Delaware. Filed Mar. 1, 1930. Serial No. 432,313. 2 Claims. (Cl. 240—44.2.)



1. An adjusting and supporting device which comprises a mechanism supporting partition, a plurality of rods disposed thereon, a frame slidably supported on said rods, a plurality of rods extending from said frame, a second frame disposed thereon, one of said second mentioned rods engaged with one of the first mentioned set of rods and movable thereby to slide the first frame along its supporting rods, a lamp support disposed adjacent the second frame a plurality of rods extending from the second frame to the lamp support, means on one of said last mentioned rods to engage one of the rods extending from the first frame to the second frame whereby to slide the second frame along its supporting rods. and means permitting the engagement of another of the rods extending from the second frame to the lamp support with the said rod extending from the first frame to the second frame to cause a movement of the lamp support in a plane at right angles to the movement of the other two frames when the said rod extending from the first to the second frame is turned.

◆

1,862,364. FILM GATE FOR MOTION PICTURE MACHINES. CHARLES L. HEISLER, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed Mar. 27, 1929. Serial No. 350,403. 2 Claims. (Cl. 88—17.)



1. In a motion picture machine, a film gate comprising an aperture plate having guide runners thereon, a movable supporting member, a flexible strip secured at one end to said member, a plurality of longitudinally aligned runners adapted to press a film against the guide runners of said plate and means connecting the longitudinally aligned runner with said strip, the runners engaging the strip at their adjacent ends whereby the raising of one runner by the passage thereunder of a splice in the film initiates the raising of the runner next following.

2. In a motion picture machine, an aperture plate having film guide runners thereon arranged in sections, the section opposite the aperture in said plate being offset at right angles to the plate with respect to the adjoining section, and a shoe having resiliently mounted runners comprising relatively offset sections arranged to cooperate with the respective sections of said guide runners to cause the film to be given a slight kink in passing from one section to the next.

Answers To Patent Inquiries

Q. Is it an advantage to have a patent issue without any contest in the Patent Office? *R. V. C., Cheyenne, Wyo.*

A. Usually not, since the contest brings into the record the nearest patents and gets the Examiner's opinion on file as to wherein applicant's invention differs thereover so that in a sense the patent is semi-adjudicated after a contest in the Patent Office, when without such a contest it would probably be subject to suspicion by opposing patent attorneys who later reviewed it for purposes of attacking its validity. There is practically always a contest before patents are issued because of the tremendous prior art, and the fact that the Examiner as he studies the case repeatedly while acting upon it during its normal prosecution becomes more and more skilled in its subject matter, his action is more and more accurate.

Q. I filed a patent application on my invention and afterwards improved it and asked the attorney to change the application accordingly. He said this could not be done. Please advise regarding this. *A. H. D., Raleigh, North Carolina.*

A. Your attorney was correct. New matter cannot be added to an application, as otherwise there would be endless confusion; inventors would get the benefit of several examinations for the one fee and the file would not show a proper filing date for all parts of the application. Your only recourse is to file an improvement application under a new number and date.

Q. Can the purchaser of a patented article repair it without infringing the patent? *L.C., St. Louis, Mo.*

A. Yes. The purchased article has become the individual property of the purchaser, and is like any other piece of property which he owns. He may sell it or he may use it so long as its usefulness lasts, and then throw it away or dispose of it for junk. He may prolong its life and usefulness by repairs more or less extensive, so long as its original identity is not lost. He is only prohibited from constructing a substantially new machine. He cannot, under the pretext of repairs, build another machine or article.

Q. What is the most profitable field of invention for an inventor to work in? *R. O'B., Chicago, Ill.*

A. Your own. If you cannot improve the tools and methods and products in your own business, in which years of effort have made you skilled, your chance of success in a new and unknown field is infinitely less so. There are striking exceptions to this rule, of course, but remember they are *exceptions*, and a policy based upon averages, not exceptions, is surer and safer.

Readers are urged to avail themselves of this free service for advice on the subjects of Patents, Trade Marks, Designs and Copyrights. If a personal answer is desired, a stamp should be enclosed with the inquiry; otherwise the question and its answer will appear in this department in the first available issue. Address all questions to the Patent Editor in care of THE MOTION PICTURE PROJECTIONIST. *Write on one side of the paper only, giving full name and address and business connection. (Only initials will be published if requested.)*

Q. What are the rights of an employe to a patent on his invention as against his employer? *E. F., Cincinnati, Ohio.*

A. If he is hired to improve a machine, for instance, the patent belongs to his employer. On the other hand, if he is hired to run a lathe, and invents a new painting process or something else not connected with his work, then the invention and patent belong to him. This is the simple formula on which the law is based but there are many modifications which might apply in individual instances. A good Patent Attorney's opinion in each specific case should be obtained.

Q. After my patent has been issued, is it possible to get broader claims in it? *Wm. T., New York, N. Y.*

A. Yes. This can sometimes be done by reissuing the patent providing the failure to claim the invention properly was due to inadvertence, accident, or mistake. There are many decisions as to just what constitutes these. Also the application for a reissue must be filed within two years of the issued date of the patent.

Q. Is there any limit to the number of claims permitted in one patent? *R. F. E., Newport, Rhode Island.*

A. No. But recently the Patent Office has put into effect a rule that for every claim originally filed in a case or finally issued in the patent over twenty, an additional filing fee, or final fee of $1.00 must be paid. If the applicant, through his attorney, files a needlessly large number of claims which do not patentably distinguish from one another, the Examiner may reject the case on the ground of "multiplicity." Patents have been issued with as many as 389 claims, although the average week in and week out is between 6 and 7 claims. It is interesting to note that the average number of claims in patents taken out through the offices of most advertising attorneys is considerably below the average for all patents above, and that the average of patents issued to the Patent Attorneys for large corporations is considerably above. For instance, the author served one large corporation nearly six years, averaging throughout the period twenty-five claims per patent on a large number of cases of all kinds, both simple and complicated. A large number of claims does not always mean greater protection to the inventor, but it often does.

Q. A neighbor has offered to back me to finance patenting and marketing my invention, providing I include his name as co-inventor. Is it all right to do this? *A. D., Albany, N. Y.*

A. No. If your neighbor is not in truth a co-inventor and an unfriendly party learn of the arrangement, the patent can be declared invalid. You can doubtless satisfy your neighbor by giving him a 50% interest in the proceeds made out of the invention (be on your guard not to assign outright any portion of your title to your patent.)

Q. My employer insists I must assign my patent to him on the ground that it was developed on his time and the patent filed at his expense. The patent is outside his business and has since proven of great value and I wonder if the law requires me to do this? *M. G., Harrisburg, Penna.*

A. No. The employer may only obtain from you a shop right or license to use the invention, unless there has been previous specific understandings.

Q. Does the Patent Office guarantee the validity of claims in the patents which it issues? *Leo G., Bronxville, N. Y.*

A. No. The Patent Office merely makes as thorough a search as possible and does the best it can with the facilities it has on hand to prevent the issue of invalid patents. They do a great work as far as their facilities permit, but since any publication anywhere in the world may be used to prove a priority to invalidate a patent they are frequently held invalid on such publications as well as on differences of opinion by the court and the Patent Office as to what is new in the field searched by the latter. Statistics show that patents are held valid and infringed in somewhat more than half of the total cases adjudicated.

The Fundamentals of Sound

By LEDWARD EVERETT

CONCLUSION

The following installment on Fundamentals of Sound concludes Mr. Evertt's interesting series.

This chapter takes in the Velocity, Wavelength and Frequency of sound and the methods of calculating them.

As a proper ending, for a series of this nature, Mr. Evertt has compiled a number of questions based upon the data published during the course of his series.

In the event the reader should experience difficulty with any of the questions a letter addressed to Mr. J. K. Hiler in care of this publication will bring forth the solution in the next issue.

Velocity, Wavelength and Frequency

IN our study of Ohm's law we found that there were three factors which always had a part in calculations of the voltage, current and resistance in any electrical circuit. We found that if we knew any two of the values we could find the value of the remaining one by one of the Ohm's law formulæ.

There are three factors governing calculations of the characteristics of sound waves too and they are Velocity (speed through air approximately 1100 feet per second), Wavelength, (number of complete waves in a certain distance of travel such as meter or foot) and Frequency (number of complete vibrations or cycles per second).

Calculation

Thus we say that:

1. The wave length of a sound wave is equal to the velocity divided by the frequency or λ (Lambda) $= V \div F$ or V/F.

2. The frequency of a wave is equal to the velocity divided by the wave length or $F = V \div \lambda$.

3. The velocity of a wave equals the wave length times the frequency or $= \lambda \times f$ or λf. As an example of formula (1). If the frequency of a sound wave is 550 cycles what is the wave length? According to the formula wave length is equal to the velocity 1100 feet per second divided by the frequency (in this case 550 cycles). 1100 feet divided by 550 gives 2 feet which is the wavelength of a 550 cycle sound wave. As an example of formula (2) let us consider that the wave length of a certain sound wave is six inches. The formula says that the frequency equals the velocity (1100 ft.) divided by the wave length (6 inches or ½ foot) 1100 ft. divided by ½ foot = 2200 which is the number of cycles per second frequency.

The Example

Working an example according to formula (3) let us assume a wavelength of four feet and a frequency of 275 cycles. Then wavelength (four feet) times frequency (275 cycles gives the answer 1100 ft.) the velocity of sound.

Application

These formulæ apply to any kind of waves, sound waves, light waves, heat waves and so on but the answer will be different in each case on account of the fact that the velocity of each type of wave is different.

The recording of sound on film gives various wave lengths of the recording according to the frequency, for the speed of the film on which the recording is done is kept constant at 90 feet per minute. Therefore to find the wave length of a recording of sound on film you use the same formulæ for sound waves in air but substituting the speed of the film for the speed of sound in air. Thus the wave length of a 500 cycle recording on film is 90 ÷ 60 = 1½ ft. or 18 inches per second film travel velocity divided by 500 (cycles per second frequency) = .036 inches or 36/1000ths of an inch = wavelength of sound on film recording of 500 cycle note.

Effect

In a sound wave of two feet wavelength then we would expect that there will be areas of compression at intervals of two feet from the source of sound to its limit of travel and in between these areas of compression there will be areas of rarefaction at equal distances from each other. The number of these areas that strike up on the ear per second determines the pitch or frequency of the sound heard. A striking proof of this is the effect heard when a train approaches blowing its whistle. As it comes nearer the sound of the whistle grows higher in pitch and as it passes the observer and recedes from him the pitch of the sound becomes lower and lower. Remembering that a higher frequency produces sound of higher pitch, let us examine into the causes of this phenomena. If the locomotive were stationary a certain distance away the pitch would remain constant because the areas of compression and rarefaction would be equally spaced and would arrive at the ear of the observer at a certain constant number per second producing a constant pitch. If the locomotive now begins to move toward the observer its motion carries sound waves forward at the speed of its own travel which it adds to the 1100 feet per second velocity of the sound wave. This means that the last waves sent out are catching up to the waves previously sent out and crowding the compressed and rarefied areas closer together. When these "crowded together" cycles reach the ear there are more of them per second that strike upon the eardrum and thus a higher pitched sound is produced. When the source of sound is moving away from the observer, the opposite effect takes place so that the areas of compression and rarefaction are spread apart and less of them strike the ear per second which causes a lower pitch to be heard.

Conclusion

The vital points to remember in this lesson are first, that sound is a series of compressions and rarefactions of air, second that the pitch of the sound depends in general on the number of these compressions and rarefactions, or cycles, which strike upon the ear per second, third that quality in a sound is dependent upon its overtones or harmonics, and fourth that the overtones are absolutely necessary for intelligibility of speech.

Questionnaire

1. What determines the pitch of a sound?

2. What gives a sound quality?

3. What is the hearing range of a normal person?

4. What is the frequency of the highest cello note according to fig. 13?

5. What is the wave length of sound when the frequency is 1500 c p s?

6. The speed of film travel in sound-on-film recording is 90 feet per minute. What is the wave length recorded on the film for a sound frequency of 100 c p s?

7. Why should the natural period of vibration of each piece of recording apparatus be kept above 6000 c p s?

8. If you were on a ship and a shot were fired across your bow what would you expect it to sound like as it approached, when past and receded into the distance? Why?

9. Why does the ear fail to "hear" frequencies higher than about 20,000 c p s?

10. Why is it necessary to record overtones or harmonics as well as the fundamental frequency?

Fit the Screen to the Theatre

BY S.M.P.E. SCREEN COMMITTEE

The following article is reprinted with permission from the Journal of the Society of Motion Picture Engineers, issue of August 1932, and the committee members listed herewith.

It is one of the most comprehensive reports on projection screens yet released by any scientific body and as such is important to every projectionist in the country.

Its appearance in THE MOTION PICTURE PROJECTIONIST *immediately after release by the Society is in accord with the policy of this paper to make immediately available to its readers material from other journals pertaining to projection and not ordinarily within the reach of our readers.*—THE EDITORS.

NEW *Types of Screens.*—Since the last report of the Committee, there have appeared several new developments in screens that deserve notice. Those that have come to our attention are the following:

Screens of embossed material coated with ordinary white pigments have been introduced by several manufacturers. The indentations are about ⅛ inch square with a spherical contour, either convex or concave, and of about 1/16 inch relief. The purpose of this treatment is to obtain more uniform light distribution than is usually possible with an ordinary, flat, diffusing surface. Even diffusing screens with smooth surfaces frequently exhibit some loss of brightness at angles of 50 degrees or more from the screen normal, and also in some cases have a slight glossiness at the specular angle which is undesirable because of the tendency to glare. The embossed screen tends partially to overcome these two deficiencies according to tests submitted by one manufacturer. However, it should be pointed out that a good flat screen is relatively free from such defects also.

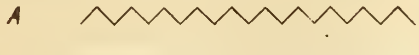
Another interesting development is the metal mesh screen. From the rear, the screen resembles ordinary metal mesh material; on the front, one sees small squares approximately ⅛ inch wide, consisting of white diffusely reflecting material. At each corner of the squares. there is a minute open space for sound transmission. One outstanding advantage of the screen is that there are no seams. The optical properties are similar to those of the fabric base screens.

A very recent type of screen attempts to combine the properties of diffusing and specular type screens. This is done by means of a combination surface (on a fabric base) which has small diffusing and metallic areas, side by side, the areas being small enough to be indistinguishable at a distance from the screen. The Committee has no data on its reflection or other characteristics and, hence, can not further describe the screen.

Another screen may be made of tiny glass beads held together by a suitable binding agent. The combination has sufficient tensile strength, and is porous enough for sound transmission. The screen is not at a practical stage of development as yet, but is merely mentioned as a possibility.

Standardization.—In previous reports, the Committee made recommendations on acoustic ratings, light reflection measurements, and sizes for installation.[1] Relevant material on these subjects has been referred to the Committee on Standards and Nomenclature for action.

Maintenance.—In the following table are shown measurements made by one of the members of the Committee in his laboratory on the light reflection of screen samples procured from field installations. These supplement data previously published, and are given to emphasize further the importance of surface maintenance and the harmful effect of dust and dirt on projection.[2]



Suggested Idea for a Screen With Double-Lens Projector to Secure Stereoscopic Effect. (A) *Cross Sectional View of Screen.* (B) *Front View of Screen.* (C) *Projected Light Angles to Proposed Screen.* L & R—*Twin Lenses of Projector*

S. K. WOLF, *Chairman*

J. L. CASS	W. F. LITTLE
E. R. GEIB	A. L. RAVEN
H. GRIFFIN	H. RUBIN
J. H. KURLANDER	C. TUTTLE

TABLE I

Total Reflection Factor

(1) Diffusing Screen

	Per cent
New	85
Used 2 years	60
Used 8 months; washed	69
Refinished by exhibitor	65
Refinished by manufacturer	82
Sprayed; cellulose coated	76

(2) Beaded Type Screen

New	70
Used 3½ months	50
Used 4 months	61
Used 4¾ months	38
Used 9½ months	59
Used 15¼ months	47
Used 16 months	60
Used 18 months	51
Used 19 months	57

It will be noted that the results are in terms of total reflection factor and differ, therefore, from data published previously, which gave the reflection at a single angle. It is believed that the present method is more informative of the effect of aging on screen reflection at all angles of observation. It was possible to make the observations so because they were made in the laboratory with facilities available ofr the measurement of total reflection. With screens in place in the theater, it was feasible to determine only the reflection at a single angle.

The loss of light caused by the dust is obtained by comparing the values for the used and the new screens. It is evident that the loss is often considerable, and also that there is no consistency. Some screens used only a few months are much poorer than those used for a year or more. The conclusion is obvious that conditions under which screens are used vary the rate of deterioration. It is highly important that dust and dirt be kept from the screens; they should be covered when not in use; air that carries dust should be prevented from circulating through them; and they should be cleaned periodically with vacuum cleaners or by some equally effective method.

The Committee has had the opportunity to study the results of resurfacing as done in the theater. At first, it was hoped that surfaces could be renovated satisfactorily by spraying and painting screens when in place. However, it is the present opinion that the process of resur-

---

REFERENCES

[1] Report of Projection Screens Committee, J. Soc. Mot. Pict. Eng., 17 (Sept., 1931), p. 437.

[2] Report of Projection Screens Committee, J. Soc. Mot. Pict. Eng., 18 (Feb., 1932), p. 242.

facing has not been generally successful. It requires skill and experience, and even with much care still leads to ununiform reflection and cloudy effects that are obtrusively apparent. Whether or not methods will be later devised to eliminate these difficulties is problematical.

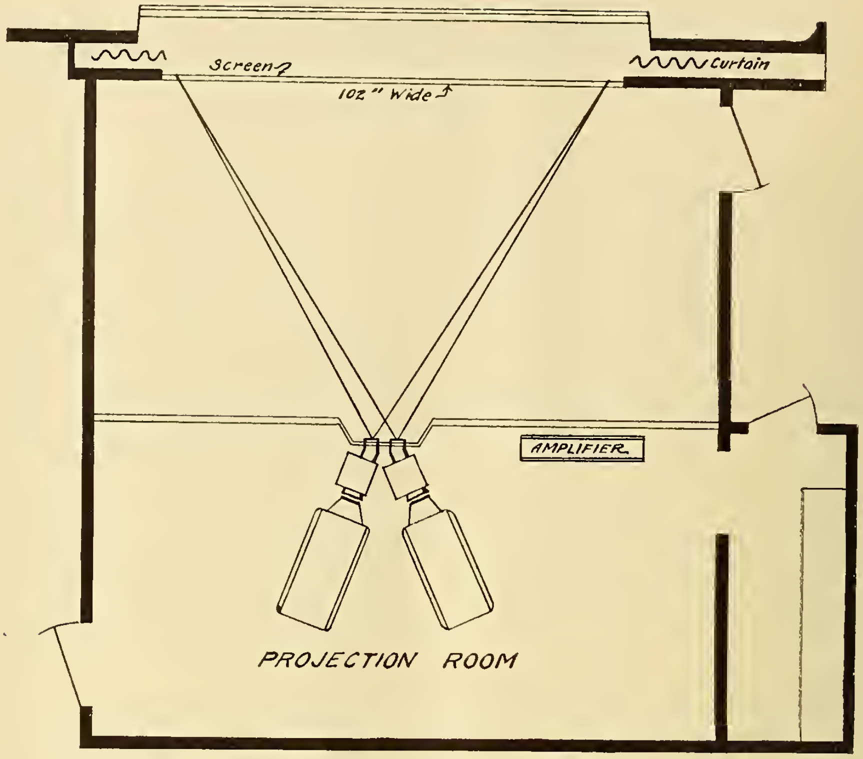
Dust and dirt also cause deterioration of the acoustical properties of screens by clogging the perforations and pores which aid sound transmission. The remedy is quite simple. The screen may be either cleaned with a vacuum cleaner possessing strong suction or subjected to a bath of compressed air to drive the dirt from the pores.

Pigments.—Yellowing of screen surfaces is another problem that is of interest to both the manufacturer and the exhibitor. Old screens acquire a yellow tinge, which causes a loss of reflection and imparts a dull tone to projected pictures. There is not a great deal known about the causes of such discoloration and methods of preventing it, although it is the general opinion that the vehicle, and not the pigment employed, is usually the ingredient that yellows. With the scant knowledge available, it is impossible to make specific recommendations.

The following general rules concerning vehicles have been furnished in response to an inquiry to the National Lead Company:

> "While in search of the type of pigment or bead for most efficient reflectance, do not overlook the importance of the vehicle with which application and continued adherence of these surfacing mediums is made possible. In considering the selection of a vehicle, the following precautions might well be observed:
>
> (1) Do not employ a vehicle that will cause premature yellowing.
>
> (2) Do not employ a vehicle that will too rapidly impair the tensile strength of the fabric, causing premature rotting of the screen.
>
> (3) Do not employ a vehicle of such high elasticity that it will remain 'tacky,' occasioning excessive retention of dirt.
>
> (4) Do not employ a vehicle that dries to a point of brittleness, as failure to bind the bead or pigment will result.
>
> (5) Do not employ a vehicle of so bodied a type as to bridge over or unduly clog the small apertures in perforated screens."

Light and Reflection Measuring Devices.—A simple device for measuring screen illumination and reflection would be a valuable asset to the projectionist. At present, there exists no such aid to assist judgment as to the amout of light available for the motion picture observer. Judgment is based on past experience of the individual manager or projectionist, and is subject to human limitations. It would be desirable to minimize or at least to supplement the human element by means of instruments as convenient and trustworthy as voltmeters. In this way, the reflecting properties of the screen could be checked monthly and the illumination from a projector checked as frequently as is necessary.



Plan View Showing Projectors and Screen for Rear Projection.
(The Screen is of a Translucent Material)

In the past the outstanding instrument for this work has been an illuminometer involving the comparison of a standard light source with the test object. The method requires skill and practice on the part of the observer and, for this reason, does not readily lend itself to theater use, except in the hands of a trained engineer. Its use is complicated by variation of reflectivity with angle of observation and by the factor of color, which, while real and important, is not simply evaluated. On the whole, without discounting its value, necessity even, it does not appear to meet the requirements for simplicity and practicability necessary in a device to be used by laymen.

More recently, there has been introduced a compact photo-cell type of photometer, which eliminates some of these difficulties. At the same time, other difficulties arise that reduce its value in its present state. Before discussing this instrument further, some analysis of the general problem of light reflection measurement is necessary.

To determine the reflection factor of a diffusing type of motion picture projection screen, we compare the ratio of the light reflected to the light incident. This is what the comparison illuminometer can do for any point. The photo-cell photometer is dependent upon the average brightness of the entire screen rather than upon the brightness of a small section, and will give accurately the reflection factor for the screen only if the screen illumination and brightness are uniform throughout. The value obtained for the brightness, *i. e.*, for reflected light, will be in error because of unequal response of the sensitive element to light at different angles of incidence. For a uniformly bright screen, a simple correction factor is applied to obtain the true value; for an ununiformly bright screen no general correction can be applied. In practice, the screen illumination will vary from place to place, the variation extending over a wide range, being frequently 50 per cent and in some cases as much as 100 per cent or more. The incident light may be measured over the entire screen surface in order to offset the effect of ununiformity in determining the incident light. The ratio of reflected to incident light gives a figure related to the total reflection factor of the screen. It will be seen that measurement would be simple if screens were uniformly illuminated, whereas in practice complications are introduced that make strict accuracy difficult, if not impossible.

The photo-cell device may, however, be of practical use in measuring relative values of screen brightness over a period of time. Thus it can be used to regulate screen illumination by providing a measure of its constancy and uniformity. In the hands of an expert, it will also yield information that may be valuable in determining the depreciation of screen surfaces. One of its main assets is that it indicates directly and avoids human uncertainty. More research is being done to eliminate present handicaps and, in the near future, it may be made more generally applicable to theater uses.

A simple, yet reliable, method of

(Continued on page 29)

Using Projection *in* Photography

By FARCIOT EDOUART

Part I.

NOT since the beginning of Motion Photography in 1892, when Thomas Edison invented his Kinetascope, has the demand for special photographic genius and ingenuity, to develop new and effective money saving mediums and devices, been more significant than it is today.

Present day process photography has great possibilities to accomplish this, and for lucid explanation, should be divided into two groups. First, those shots whose effects are more commonly recognized as miniature, glass painting or trick shots producing by various means of deception or illusion. Secondly, those shots which are unrecognized as trick or deception shots but are generally inserted into a picture to give added production value. They are mostly composite shots made with the working picture cast by combining them in a highly specialized manner with moving action backgrounds, resulting in a scene which appears in its entirety to be actual .

This second class of process work, because of its untouched new fields, unlimited possibilities and close supplementary alliance in combination with straight cinematography, affords possibly the greatest present economic advantages of the two, and is the type of shot described in this discussion. Such shots are resorted to and attained by means of special methods because economic limitations, production difficulties, or mechanical reasons make it impossible or impractical to secure the required results by straight ordinary photography.

The tremendous possibilities of this special group as a means of helping the industry retain the high quality standards of production and entertainment values already established are becoming more obvious every day. Also, this constitutes a means of producing as good, (and in many instances) better results at considerably reduced costs.

The question, therefore, immediately arises: What is the ultimate purpose of these special photographic processes? Are they eventually to become mediums which will do away with locations, with settings, and even with the production cameraman? The answer must be emphatically, "No!" Those of us who are most conversant with these processes, who have used and developed them, must be the first to admit their limitations no matter how boldly we set forth their advantages.

Having been actively engaged for the past six years in developing and operating the transparency process (also known as the Dunning Process), and more recently working with the projection process, I will confine my talk to those two methods.

First, the straight transparency process which was invented by Roy J. Pomeroy and jointly fully patented by the Paramount-Famous Lasky Corporation, is essentially a scientific photographic method for introducing characters, sets, or objects into a background previously taken, from which a specially prepared print is made which is run in contact with panchromatic negative in a camera so that a resultant finished negative is produced by the use of complementary color lighting, that incorporates the characters, sets or objects into the previously taken backgrounds, so that they appear to have been taken at one and the same time.

NOT since the invention of motion pictures has any single development been so significant to motion picture art aroused so much interest and discussion as the method of using projection as an aid to photography. This method is generally known as the transparency process.

It is now thoroughly perfected and is used in all the studios on the coast. Its greatest asset is its economy for it has eliminated the extravagance of sending casts and technical crews to locations in distant parts.

The process is fully described in the accompanying article and will undoubtedly fascinate projectionists as it is a use of their own technique and art.

The second section of this article, even more interesting, will appear in the next issue of this publication.

The article is published by permission of the author Farciot Edouart, head of transparency photography for Paramount Publix and by permission of the Academy of Motion Picture Arts & Sciences.
—THE EDITORS.

Conversion Method

The operation of the process requires extreme care, balance and patience; a knowledge and practice of photographic chemistry; and experience in standard laboratory practice; a thorough knowledge of filters and complementary colored lighting and spectrum analysis; an understanding of perspective, its theory and practice; a thorough knowledge of camera work and lighting; and the greatest requisites of all are patience, care, and perseverance.

Assuming we have a suitable background scene into which we wish to introduce a character, we have a special print made which, after being developed, washed, and fixed, is put through ten additional laboratory and chemical operations which change its character from a black and white silver bromide print to an orange-red dye image print. When viewed through a Wratten and Wainwright Filter No. 26 Sterro Red, this print is perfectly transparent, with no part of the orange-red image any more visible than the clear celluloid base of the print itself.

Also when viewed through a W & W Filter No. 46 Nite Blue, which is complementary to Filter No. 26 and the orange-red color of the print, the orange-red image is converted to a black and white character identically similar to the original black and white state the print was in before the last ten processing operations started.

This print has now been converted into a transparency background and is placed emulsion to emulsion with panchromatic negative in a camera adjusted to take two films and equipped with a magazine. The camera is then set up twenty-five or thirty feet in front of a blue screen which is lighted with a minus-red blue light which corresponds as nearly as possible to the W & W Filter No. 46 as mentioned above. The screen must be large enough to cover the whole picture aperture.

The character is then placed in a position between the camera and the blue screen in the correct perspective or natural position relative to the background. He is then lighted with an orange-red, minus blue light which is complementary to the light reflected from the blue screen and which is at the same time transparent to the orange-red transparency background print in the camera, care being taken that no red light gets through onto the blue background screen and that no blue light gets onto the front or photographed side of the character; also that no white or any other kind of light gets on either the screen or character. In other words, the more complete the color separation, the better.

As mentioned above, the transparency print when viewed through a No. 46 filter is converted to a black and white character image—so also is it converted as though it were a black and white print when shooting at the blue screen. Likewise, the transparency print is transparent to orange-red light similar to Filter No. 26. So also it is transparent to the character lighted with similar light.

Panchromatic negative being sentitive to red and all other light, photographs the character through the transparency as though it didn't exist, and the blue screen at the same time prints the background in on the panchromatic negative. The character, by virtue of being a solid, does not allow any blue light to pass through him to reach the transparency in that portion of space he takes up, therefore forming a perfect mask or opaque mat which allows the blue screen to print in only that background which exists all around but not over him. Being lighted with red light, he photographs direct through the transparency in that matted-out portion of the screen he covers, thereby making our composite picture partly photographed directly with red light and partly printed simultaneously with the blue light. The resultant negative is, accordingly, a composite of the former background and the character, the background being a dupe and the character being original in the new negative.

A special make-up is required and has been developed to use with the red lighting, being generally two shades darker than regular make-up used in black and white lighting.

Details of Practice

It must be understood that this transparency process requires considerable personal skill and technique in every branch of its various operations and practices. Constant thought, care, faith and hours of painstaking effort are required to master it successfully, and it remains essentially a matter of personal craftsmanship and ability. It will be found that numerous variations and improvements and little tricks can be applied to meet various local laboratory conditions.

A complete record and log is always kept of every roll of transparency processed, relating to printing and processing date. exact time and temperature of every operation, the specific bath mixture and date of mixture, and special notes and remarks of the various operations on every roll. We have complete records of every roll processed in the past year, which have proven an invaluable aid for standardization and determining and mapping out the numerous little improvements being effected.

This is briefly the principle and method of the complementary color and lighting components employed to accomplish the straight transparency process.

Transparency projection shots are accomplished more simply and do not require any change in regular production camera or photographic set-up. The projection equipment required consists of the most advanced superhigh intensity or latest type mirror-arc and condenser equipment. The best screen we have discovered to date, after testing some forty-two different mediums for re-photographing a transmitted projected picture, is a uniformly sand-blasted plate glass processed on one side and etched with a hydrofluoric acid bath on the sandblasted side.

Two types of projection heads are used; either the Super-Simplex rear shutter projection head which we use for all moving background shots or a regular rear shutter Simplex head converted into an exceptionally rigid and steady projection unit by reconstruction and utilization of a Bell and Howell camera movement. This head is used for all stationary blackground shots where absolute steadiness is required.

The Projection Shot

Various focal length projection lenses are used, all of the highest aperture obtainable, a selection being made according to the requirements of the shot and the space available for the set-up. It is imperative to keep all extraneous light from hitting the back side of the screen, except that which is used in projecting the picture. The picture is projected in reverse so that when re-photographed by transmitted light from in front of the screen it assumes its normal relative position and direction. It is very necessary that all subjects, sets, etc., placed in front of the screen be lighted in such manner so that a minimum amount of stray or leak light reaches the ground glass surface of the screen upon which the picture is being projected. It is very obvious that any misdirected light reaching the surface of the screen will add an overall illumination and will cut down the definition and reduce the brilliancy and contrast of the projected picture and thus give a very flat wash-out image to be re-photographed. These defects occur in direct proportion to the amount of leak light striking the screen.

It is necessary to use the latest super-speed type negative emulsions on re-photographing. It is also obvious that the camera and projection shutters must be exactly synchronized with each other during their open periods so that the maximum of exposure light from the screen may be obtained. No special make-up is necessary other than that required for straight black and white photography. It is necessary, however, to use as much cross lighting as possible. It will be noted in actual practice that if a sufficiently brilliant picture is being projected, the screen will stand a reasonable amount of front leak light.

Trucking shots, pan and Akeley shots may be used wherever the outside limits or edges of the screen are masked by the set or do not come within the limits of our picture angle.

The common proceeding in shooting is to synchronize the sound system. then the projector shutter, and lastly the camera shutter to the projector shutter by means of the camera racket kick-out clutch, then everything is in readiness to be turned over for photographing projection process "take." With an experienced fast projectionist and sound crew, all these operations should be accomplished in not more than thirty seconds. It is advisable, on completion of the shot, to allow the distributor of the sound system to stop in sync before turning off the last switch. as the distributor and projector motor will then always remain in the synchronous position. This procedure facilitates getting the projector shutter ready for the followink take and very definitely speeds up production shooting. It is not necessary for the camera motor to stop in sync and it can be kicked-out immediately after the scene is finished, as is standard practice.

The cameras used in this process may be Bell and Howell, Mitchell, DeBrie, or any other camera having a shutter opening comparable to that used in these cameras.

Not a "Trick" Process

It will be noted in shooting projection shots with incandescent light that the projected picture is more actinic photographically than it appears to be visually and will pick up or photograph stronger than you would expect. In other words, when incandescent set lighting is used, the foreground can be lighted to a slightly more brilliant key than the lighting on the projected picture appears to be and the finished photographic balance will be almost uniform. This sense of balance must be acquired by actual experience. The apparent visual difference in balance between the transmitted screen illumination and set illumination is not only due to the actinic difference between arc and incandescent light sources, but also because we are photographing simultaneously with both transmitted and reflected light.

The density of the prints used for projecting must be controlled entirely by what is desired in the finished shot, and how much amperage and illumination it is practicable to use in projecting the desired picture.

All stationary objects should be printed on Bell and Howell perforated positive. It will be found advisable to test out the Bell and Howell perforations as some rolls of positive are imperfectly perforated and give more movement than others. It will be found that the Bell and Howell projection head (if proper care is taken in construction) will give extremely steady results if the print perforations are absolutely true, otherwise it will be extremely difficult to project an absolutely steady picture on a long throw.

The general quality of the re-photographed picture is remarkably good, considering it is a dupe. There is an apparent stereoscopic depth that photographs in an image projected onto

(Continued on page 34)

Sound Head Troubles

By LLOYD HARDING

IN a recent tour of motion picture theaters, the writer was impressed with the fact that a goodly proportion of troubles in the sound equipment originate in the sound heads of the projection equipment. That this is so is somewhat of a reflection on someone, we will not say who, for this type of trouble is the easiest of all to clear. In several cases the sound reproduction was marred by a distinct 96 cycle tone which came and went intermittently. One has but to hear this particular tone to recognize that it is caused by one thing only,—weaving of the film as it passes before the light beam in the sound head. The fact that the tone is one of 96 cycles denotes that it is caused by 24 frames of four sprocket holes per frame passing the light beam each second. The ensuing interruption of the beam 96 times per second produces the tell-tale tone in the speakers.

If the tone were constant the projectionist would know that the fault was not with film weaving, but that the lateral adjustment between the light beam and the sound track was at fault. When the tone is heard constantly it indicates that the beam is being cut continuously by the sprocket holes.

In the first case, that of intermittent 96 cycle tone, the remedy is to inspect the sound gate thoroughly and to ascertain what it is that is causing the film to weave. A bent flange on the guide roller is often found to be the cause, while in most cases it will be found that the bearings on which the guide roller runs are not tightened up snugly. Another common cause of weaving is that the spring, adjustment of the guide roller becomes weak and thus fails to exert pressure laterally on the film as it passes the beam.

The second case, where the interrupting tone is constant, means that the lateral adjustment is so far wrong that the light beam is being cut by either the sprocket holes on one side or by the frame lines and picture on the other.

All sound heads in use at the present time are provided with means for making lateral adjustment between sound track and light beam by one of the two following methods. In one case, the adjustment is made by moving the optical system laterally (from operating to drive side of projector and vice versa) and in the other case the same result is attained by allowing the optical system to remain stationary while the sound gate guide roller is moved laterally the required amount.

In either case, the correction can be made while the film is being run through the sound heard during rehearsal. Never do it during the running of a show. Now while the film is running through the sound gate and the 96 cycle note is being heard from the horn in the booth, move the optical system, by means of its adjustment screw towards the drive side of the projector. When the tone disappears from the sound the correct adjustment has been reached. Now tighten up the locking arrangement on the adjusting screw and listen further for the disturbing sound. If none is heard the trouble is cleared. If however the tone is again heard continue the adjustment until it is eliminated. In the case of apparatus in which the optical system is stationary and the guide roller adjustable, move the guide roller by means of its adjusting screws toward the operating side of the machine until the tone disappears.

When the trouble is with the film weaving back and forth before the light beam the remedy is usually not so simple. If the flange of the guide roller is bent it is usually best to replace it with a new part, although in an emergency the flange may be straightened with a pair of pliers. A weak tension spring should be replaced. In the case of loose bearings holding the guide roller it is only necessary to tighten them to a snug adjustment and then go through the process of lining up the sound track and the beam by means of the adjustment method provided with that particular installation.

There are, of course, other troubles besides sprocket hole hum that originate in the sound head. When trouble has definitely been traced to the sound head, the following tests will help to locate the source of trouble.

The Exciter Lamp

If this becomes blackened through age, or is dirty it will cut down the volume, but not the quality of the reproduced sound. To bring the volume up to normal, it will then be necessary to run the volume control near its maximum value, whereupon the unavoidable hum from the amplifier will become objectionable. Therefore if the sound is weak or if there is no sound at all from film on one machine, look to see if the exciter lamp is lit at all, and if so, whether it is furnishing enough light to the optical system. If not, replace with a new lamp.

The Exciter Lamp Socket

Often the above conditions arise even though the exciter lamp is lit. In this case it sometimes happens that the spring pin contact in the center of the socket has pushed the lamp up in the socket. This may be due to the fact that the set screw contact became loose and results in the filament failing to be focussed on the slit. The card test will reveal this condition immediately. Place an ordinary white card between the optical system and the photocell. If the exciter lamp is in the correct position the light from the optical system will show up on the card as a round sharp disc of light. If the exciter is too high or too low the circle of light will not be perfect but will be shaded on the bottom or on the top as the case may be. If the exciter lamp is not in the correct position laterally, the shadow will appear on the light circle either to the left or to the right.

Optical System

Dirty condenser and objective lenses will cut down the volume, but not the quality. However, if there are globules of oil on or between the lenses of the objective, their refractive effect will be spoiled, and the slit will be improperly focussed on the film, with consequent distortion of the sound. If the optical system is out of focus, the sound will be drummy—such sounds as that of "S" will be missing, and music will lack brilliancy. If the slit is out of rotational adjustment, or is partly blocked, the sound will be distorted and speech garbled. However, it is to be noted that unless the light is entirely cut off by a totally blocked up slit, or total impediment in front of one of the lenses, there will still be sound, only it will be of poor quality.

Sound Gate

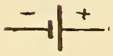
This is one of the most important parts of the sound head, for much of the quality of sound depends upon this and the way in which the film is pulled through it. It goes without saying that the surface of the gate must be clean and smooth—unmarred by any scratches. Also the teeth of the constant speed sprocket, or the surface of the impedance roller, must be clean and not worn. In the latter case, be sure that not only does the roller turn, but that it rotates at the same speed as that of the film passing around it, that is, there must be no slippage. Any unevenness of motion of the film through the sound gate, due to any of the above causes, or due to the viscous damping being too tight, results in poor sound. The tones may sound harsh and fluttery, especially at the higher frequencies and the background noise may be increased. If the sprocket or roller is eccentric, or the shaft bent, "wows" will

(Continued on page 34)

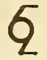
Symbols for Amplifier Circuits

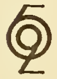
By Milton Lowenstein

Sources of Electricity



Battery

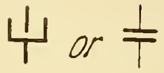

D.C. Generator (or Motor)


A.C. " "

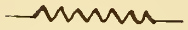
The battery, a source of electricity, due to chemical action, is the purest form of electricity known today. One type is the dry cell which cannot be recharged, (for flashlights, photoelectric cell voltages, etc.) The other is the storage battery which after it has given off the required amount of rated current-hours (watt-hours) it can again be recharged with an outside source of electricity.

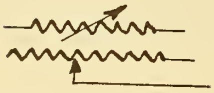
The generator, a source of electricity due to magnetic mechanical action is a rotating piece of machinery whose rotor has to be driven by an outside source (such as a motor, gas engine or steam engine.)

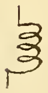
Circuit Components

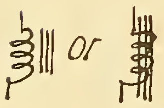


Capacity (Fixed Condenser)

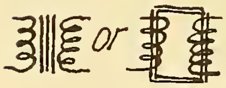

Resistance (Fixed)


Resistance (Variable)


Inductance (Air core) (RF Choke)



Inductance (Iron core) (Choke or Retardation coil)



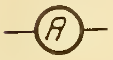
Inductance (Iron core) (Transformer)

Capacity is the term given to the part of an electrical circuit which stores up electricity. The condenser is the common name for such a part. Another use of a condenser is to allow AC to pass and to hold back DC.

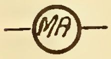
Resistance is the part in an electrical circuit which holds back more current from flowing than is intended. This may be fixed or variable (such as the charging rheostats, filament rheostats, arc-lamp rheostats, etc.). Rheostats are commonly used only in DC circuits.

Inductances are used to either build up or decrease voltages. Single coil, iron core inductances are used to suppress the AC current and allow the DC to pass (opposite to the condenser). They are used in power supplies and are termed choke coils or retardation coils. Another form of inductance is the transformer. The transformer is used to either step up or down AC voltages (such as 110 volts from the main to any voltage required for the particular vacuum tube used in the amplifier. The transformer is also used as one means of electrically connecting two vacuum tubes in a circuit.

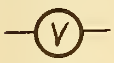
Measuring Instruments



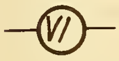
Ammeter



Milliammeter



Voltmeter

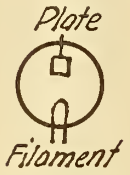


Volume Indicator

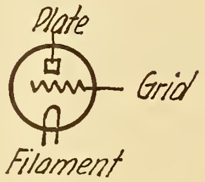
The ammeter, milliameter, and voltmeter (used by the projectionists) are fundamentally the same. The ammeter and milliameter should *always* be connected in *series* with the object to be measured (such as amplifiers, vacuum tubes, arc lights, etc.) The ammeter measures amperes and the milliammeter measures less than one ampere, (1 ampere = 1000 milliamps). The voltmeter should *always* be connected *across* the source of electricity (battery, generator, etc.) or the object whose voltage is to be measured. For example the voltage of the filaments of a vacuum tube is measured by connecting the voltmeter to the filament prongs of the tube socket and the current is measured by taking off either one of the wires to the filament prongs and connecting the ammeter in series.

The Volume Indicator is an instrument whereby one can visually measure the response of an amplifier system to various frequencies, in order to determine the efficiency of the equipment. The use of this instrument commercially is to maintain an accurate pre-set level of volume without relying upon the human ear.

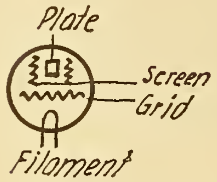
Vacuum Tubes



Rectifier (2 Elements)



(Half Wave) Amplifier (3 Elements)



Amplifier (4 Elements)

The rectifier tube is a tube which takes AC as its input and delivers DC. This tube is used in power supplies taking the AC high voltage from the power transformer and delivering DC high voltage to the plate of the amplifier tube, (such as 281s, 866s, 214As and 258As).

The three element amplifier tube is the most commonly used vacuum tube. Its action is similar to the rectifier tube with the exception that a third element is introduced, the grid. The grid is between the filament and the plate and acts as a valve. In other words it determines the amount of current passed between the filament and the plate. Where the current is small the tube is small, where the current is large the tube is large (such as 201As, 239A, 845s, 211s, 242As, etc.)

The four element amplifier tube is the same as a three element tube except that a fourth element or screen grid is introduced between the controlling grid and surrounding the plate. With this extra grid more amplification can be obtained thereby reducing the number of tubes necessary.

Laying the "Movie Bogy"*

MOTION PICTURES IN EDUCATION

A SWEEPING vindication of the movies both as a classroom tool and, within limits, as a form of childhood recreation, has just been issued by the British Commission on Educational and Cultural Films, after a two-year inquiry. Established by unanimous vote of a conference of some hundred educational and scientific organizations, and financed in large part by the Carnegie United Kingdom Trust, the commission has published an arresting first report of its national and international investigations.

No longer, it declares, is or should the cinema be treated by educators as "a bastard of the arts," but as "a handmaid in the courts of light." Though educational associations in some cases continue to pass resolutions deploring the influence of the movies, such action the commission believes to be based "less on informed criticism than on an instinctive reaction" against a force "assumed to be the offspring of alien powers of darkness."

Everywhere, however, it sees the cinema gaining prestige. "Some educators are even beginning to suspect that the form of a princess is concealed in the handmaid's garments; and that the trade is only waiting for an assurance that educators know what films they want, and will use them when they are made."

As for children's attendance at regular commercial moving picture shows, aside from the bad physical effects of sitting in a stuffy room, the commission sees few evil results and some good ones. Quoting from the report of the Chief Inspector of Schools to the London County Council just issued, it finds most of the inspectors and teachers interviewed agreed that "the morally questionable element in films is ignored by children of school age."

No Cause for Alarm

One inspector, indeed, declared: "On the whole, the investigations left me with the impression that there is no cause for alarm over the attendance of children at cinemas on account of what they see. What does emerge, however, in a very striking manner is the fact that children would welcome more of the healthy adventure type of picture showing life in other lands; in short, that children ask for children's pictures."

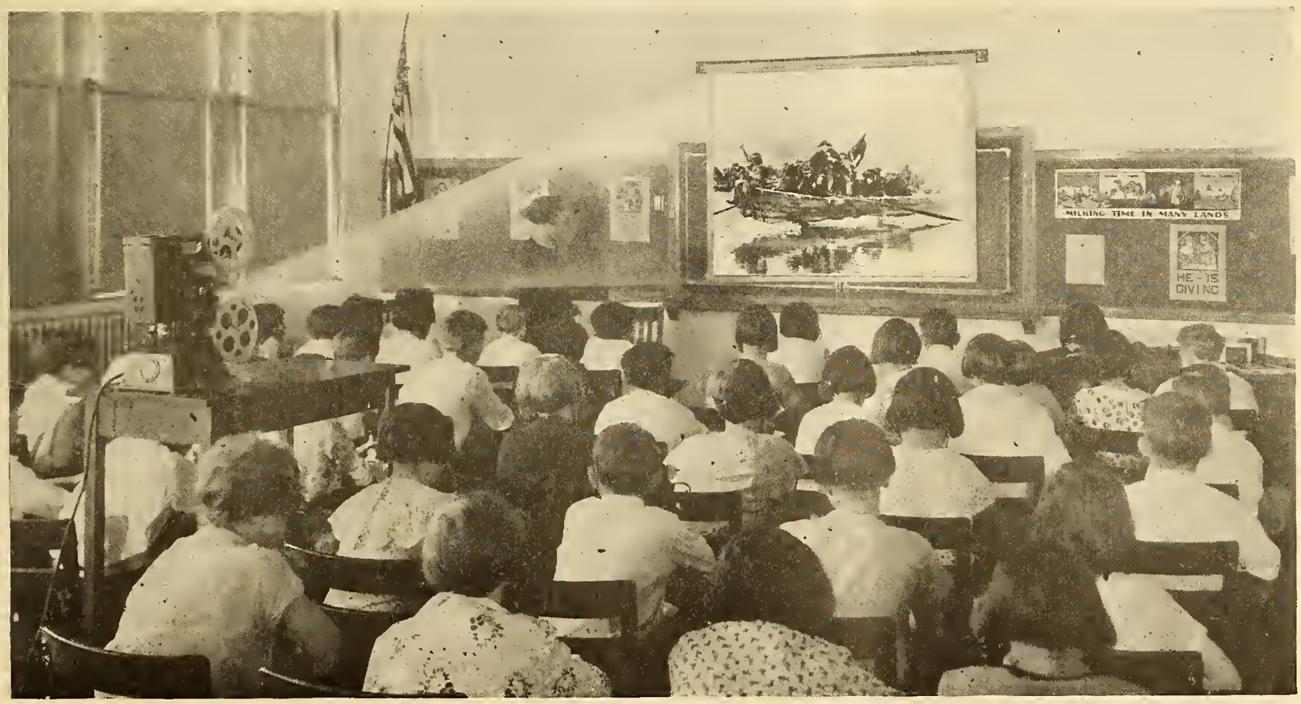
As to the instructional value of films, the commission believes that the classroom investigations already made leave no possible doubt. "We are impressed by the consensus of teaching opinion," it states; "we believe that the power and value of the classroom film have been proved, and we hope that future effort and experiment will be directed toward production, not toward further inquiries."

A generation of film-going children, the commission holds, is learning to pick up points and impressions on the screen very quickly. "It is as important to train their taste in films as in music; from the social point of view more important. If the standard of public taste is to be raised, we must begin with the children. Here the school links up again with the public cinema."

Two studies recently completed—one with silent films by the Historical Association and one with sound films by the Middlesex Education Committee—the commission cites as disproving many of the aspersions formerly cast upon the movies. The striking similarity of the conclusions of these two independent investigations is strong proof, it holds, that "the classroom film is not a toy."

From these tests the film emerges, it declares, as a stimulant, not a sedative. It is much more likely to wake up the dull or lazy boy than to send him to sleep. "The assertion sometimes made that looking at films leads to intellectual inactivity and a passive acceptance of facts on the part of the child is not borne out by our inquiries," states the Middlesex report. "On the contrary, there is sustained concentration because both the senses of seeing and hearing are directed and irresistibly held by the sound picture. An acute concentration of this kind precludes mental laziness."

Similar results with the silent picture are noted in the survey of the Historical Association. "The use of


MILKING TIME IN MANY LANDS
HE IS GIVING

Motion Picture of Washington Crossing the Delaware, Shown to Primary Grade Pupils.
Courtesy Eastman Teaching Films, Inc.

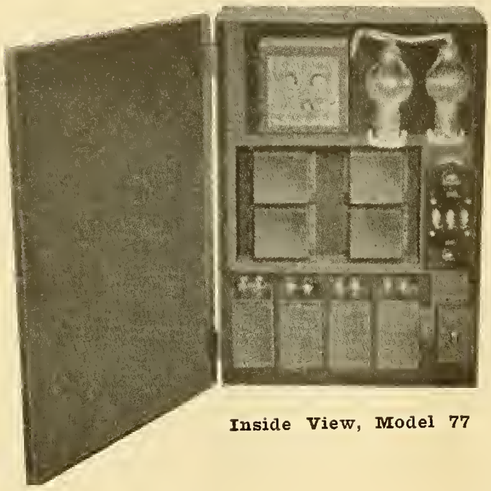
---

* Published here by permission of the New York Times and Mrs. E. T. Barhard of the New York Times Sunday Education Department.

ARE YOUR BATTERIES WEARING OUT?

a FOREST RECTIFIER

Solves Your Battery Problem Giving You Better Operation At Less Expense



Inside View, Model 77

Forest rectifiers save current, are efficient, supply unfailing non-fluctuating current, require no attention or attendance, and are always ready for service. They eliminate all "A," "B" and "C" batteries.

Model 77 supplies 7½ amperes to exciter lamp and 1 ampere to amplifier filaments. We make a rectifier for every direct current requirement on sound equipment.

A BRAND NEW FOREST RECTIFIER

A greatly improved rectifier—the result of years of experience and research is now ready. These new Forest Rectifiers will absolutely out-perform anything ever offered before. Inexpensive to own, economical to operate, easy to install and positively quiet in operation.

Available in Model No. 30 up to 30 ampere capacity for one projector. Model 25-25, up to 25 amperes to one projector and an additional 25 amperes to second projector during change over. Model No. 45, up to 45 amperes to one projector available for either single or three phase A.C. current.

Model No. 6, up to 65 amperes, and Model No. 10, up to 100 amperes, both for one projector, are now available in three phase A.C. current only.

Model No. 15 is portable, 15 ampere capacity.

Model No. 20 is stationary, 20 ampere capacity.

Front View, Model 25-25

Write for bulletins

FOREST ELECTRIC CORP.

Newark New Jersey

the film," it says, "forces children to find their own words to express opinions and to describe scenes, not merely to borrow those of the teacher or of the textbook. Thus the film, instead of helping to form the 'mass-mind'—another general criticism laid against it—encourages originality."

Thus, too, the Middlesex investigation found that "films encourage children to read more widely, increase the pupil's ability to discuss topics and to write about them. They enlarge the vocabulary, enrich personal experience, correlate the work of the classroom with the life of the world outside the school, and develop the ability to concentrate mental activities."

Improving Recollection

In addition the commission finds a general agreement that the quality of the child's recollection is improved with the heightening of the visual impression through the use of films.

"The film leaves a remarkably permanent impression. Deferred tests were given in both inquiries up to seven months after the film had been shown, and produced surprisingly good results, particularly where the subject of the film had been related to the school curriculum, and had been followed up by regular lessons. These conclusions are confirmed by school observation. For example, an inspector questions classes in various schools on films which they had seen a year before in school hours at a public cinema, after preparation and followed by lessons, and found ready and general response. * * *

"The Middlesex report gives particular attention to the effect (commented on by others) which this vivid presentation has on many dull and backward children. For the retarded pupil one of the main objectives of the school must be to discover those things in which he can interest himself and exhibit some responsiveness. The film provides such a stimulus. Formal experiments showed that the difference between the results from the brighter half and the duller half of an experimental group tested after a film lesson was much smaller than in their ordinary performance—10 per cent instead of 30 per cent—and also that the dull children showed a much greater relative advance on their own average performance.

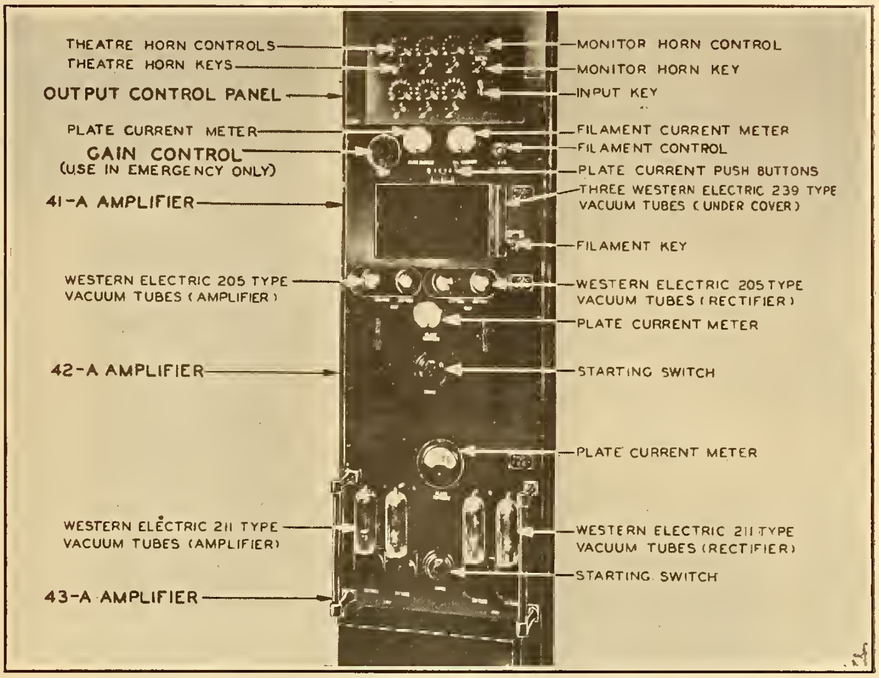
"We believe that mechanical aids of all types are likely to be proved (as knowledge of their use increases) of particular value in stirring the interest and consequently the thought of children who do not react to ordinary teaching methods."

Toward both educational and general cultural ends the commission advises the immediate setting up in Great Britain of a film institute. In its educational capacity this would advise the trade, through expert panels of teachers, on the production of school films, and would act also as an information bureau for individual teachers as to films, projectors and technique.

A Service Engineer Makes His Rounds

By IRVING WEISS

Mr. Irving Weiss, a member of the editorial board of the MOTION PICTURE PROJECTIONIST, *and the author of this article is a practising sound and projection engineer. This article is the first of a series which will appear regularly in this publication, detailing his experiences in his servicing work for the Loew theatres in the New York area. Projectionists will find these articles reward careful reading.* —THE EDITORS.


THEATRE HORN CONTROLS
THEATRE HORN KEYS
OUTPUT CONTROL PANEL
PLATE CURRENT METER
GAIN CONTROL (USE IN EMERGENCY ONLY)
41-A AMPLIFIER
WESTERN ELECTRIC 205 TYPE VACUUM TUBES (AMPLIFIER)
42-A AMPLIFIER
WESTERN ELECTRIC 211 TYPE VACUUM TUBES (AMPLIFIER)
43-A AMPLIFIER
MONITOR HORN CONTROL
MONITOR HORN KEY
INPUT KEY
FILAMENT CURRENT METER
FILAMENT CONTROL
PLATE CURRENT PUSH BUTTONS
THREE WESTERN ELECTRIC 239 TYPE VACUUM TUBES (UNDER COVER)
FILAMENT KEY
WESTERN ELECTRIC 205 TYPE VACUUM TUBES (RECTIFIER)
PLATE CURRENT METER
STARTING SWITCH
PLATE CURRENT METER
WESTERN ELECTRIC 211 TYPE VACUUM TUBES (RECTIFIER)
STARTING SWITCH

Typical W. E. Control Panel Checked by Service Engineer

THE average projectionist wonders how many theatres his Service Engineer has been to prior to visiting his particular theatre and just how many more theatres this same engineer will visit before he finally calls it a day.

Let's follow Engineer Smith around for a day and discover just what makes him "tick."

Upon arising in the morning, after his shower. shave etc., Smith sits down to breakfast. During the meal he proceeds to consult his day's schedule. The schedule calls for routine inspections of certain theatres within a particular area.

At last Smith is on his way to the first of the theatres upon the list. He has guaged his traveling time so that his arrival would coincide with that of the projectionists, which is usually one hour before show time.

Our engineer wends his way up the usual long climb of stairs to the projection booth. Once in the booth he is greeted by the projectionists like a long lost friend (this last is true in most cases for the average engineer is considered a most "regular fellow") and is immediately deluged by a series of questions, technical and otherwise. Smith answers these questions to the best of his ability.

Having completed this first obligation Smith begins the order of the day.

The object of Smith's early visit is to inspect the projection equipment when it is "dead" (an expression used when the equipment is not in use for the purpose of projecting a show). Smith inspects and makes adjustments that would be impossible after the show had started. If he were to attempt to tighten a rheostat on one of the amplifiers, for example, after the show had started, he would create disturbing noises in the sound system which would incur the wrath of the manager and most probably cause patrons to complain about the terrible sound.

The Mechanical Equipment

Smith's inspection is made in the following manner: first he inspects the mechanical details of the equipment. This covers inspection of the driving motors and their parts, such as the motor brushes. The brushes are removed one by one from the brush holders and inspected for high spots, cleanliness and the manner in which they are wearing, for if the brush shows signs of pitting, etc., it is removed and replaced. This precaution prevents trouble such as slow starting of the motor, undue wear of the commutator and perhaps failure of the motor to start. Along with the motor inspection Smith grasps hold of the motor coupling to determine whether or not the coupling pins are loose; if they are the coupling must be replaced, for should the pins loosen and fall out, the projector would stop and cause a serious break in the show. After completing the motor inspection Smith tests the takeup chain to determine its manner of riding the sprocket teeth of the takeup itself. Worn and loose chains are dangerous. When the chain becomes loose it must be tightened to prevent it from riding off the takeup sprocket and entangling itself among the costly driving gears of the associated parts. If Smith finds the chain badly worn and stretched he instructs the projectionists to replace it at the earliest moment.

The Sound Head

The inspection is now centered around the sound head. The sprockets, rollers, film guides and flywheel assembly are carefully scrutinized for possible defects. Smith knows that if the teeth of the constant speed sprocket are undercut, the reproduction of sound will be bad because of a "flutter" generally introduced by defective speed sprockets. He also knows that the sound will be impaired if the tension pad of the movietone light gate is permitted to lose its tension. The sprocket pad rollers are also tested for proper adjustment.

The P. E. C. Amplifier

Smith is now ready to test the electrical equipment and proceeds to do so by first turning the sound system "ON" and then bringing the fader to maximum position on one side. He listens carefully for noises of a crackling or frying nature for they are signs of serious trouble.

Smith has detected a noise of a sputtering nature, as though someone were frying eggs in the sound system. He carefully inspects the photoelectric cell and its related parts for loose or weakened connections. During the investigation Smith discovers that the grid leaks have tarnished ends. He removes these units and finds that the contacts are corroded and dirty which was the cause of the noise he had heard. He cleans the stub ends of the leaks with a fine grade of sandpaper and puts them back. The noise was not in evidence after this operation.

Motor Control Boxes

Smith now continues the inspection by checking the motor control boxes. This he accomplishes by removing the tubes and checking them in the 42 A amplifier. After the test the good tubes are retained and the bad ones destroyed. (This is done to prevent them being accidentally placed in the spare parts and labeled as good stock.) After checking the tubes he then subjects the tube sockets, including the prongs, to a thorough cleaning. Then various condensers and resistors in the box are looked at for external indications of a coming break-down. The indications usually take the form of burned spots on the resistors and swollen sides on the condenser cans. Smith makes a test to determine the condition of various soldered connections.

Fader

Our engineer now continues his inspection by testing the fader. With the cover removed he cleans the stub contacts of the unit and tests the sliding contact arm for proper tension. After doing this he lubricates the contacts with a thin coat of vaseline. The connections to the fader are carefully inspected and then Smith centers his activities around the main amplifier system.

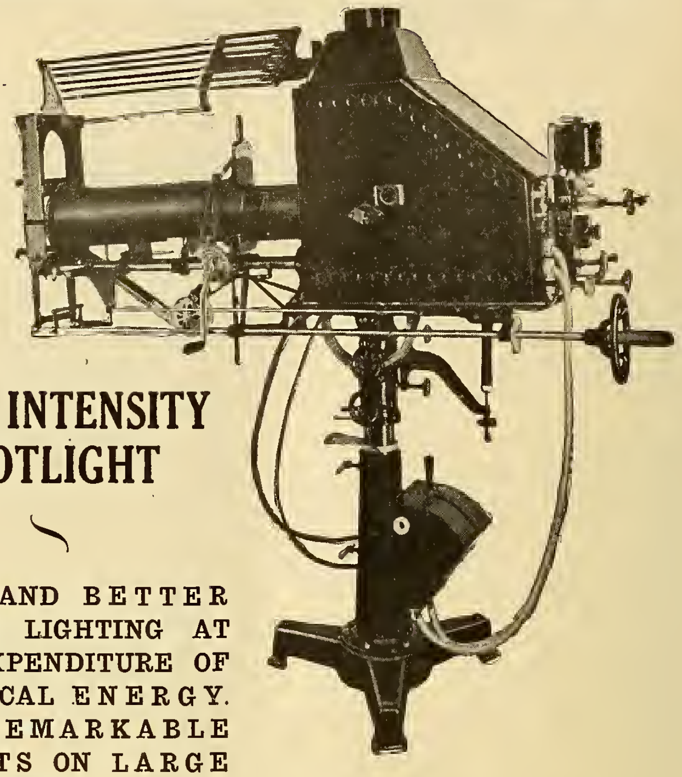
The Rack

The inspection of the amplifier rack consists of testing the tubes in the system, checking the socket prongs, inspecting rubber cradle supports for condition, investigating the safety switches on each unit, looking at transformers, reactors and condensers for signs of trouble. The chief sign is the leaking of the compound out and around the edges of the individual units. The actual cause of the leakage is due to internal shorts or partial shorts within the unit itself causing the compound to melt. The compound is poured into the unit to keep it in place and at the same time to render the apparatus moisture proof. After completing the inspection of the amplifier rack and the associated "A" box terminal board Smith proceeds to the battery room.

Batteries

In the battery room Smith inspects the charging equipment, then the batteries themselves are subjected to a gravity test. He also notes the amount of sediment collection at the bottom of the battery. As each of these items are encountered Smith carefully records the facts upon his inspection report sheet. Our engineer has found that the battery room and its equipment is in pretty good shape. This is due to the efficiency of the projectionist staff.

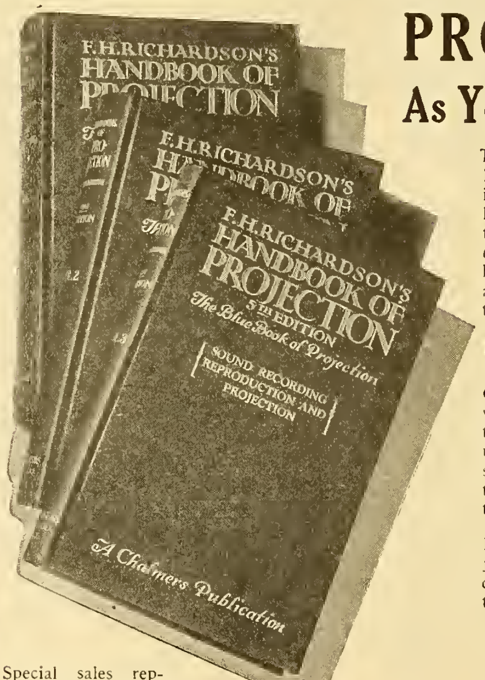
(Continued on page 34)



HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY. MOST REMARKABLE RESULTS ON LARGE STAGE SETS. - - - -

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.
H&C INC.


F. H. RICHARDSON'S HANDBOOK OF PROJECTION
5th EDITION
The Blue Book of Projection
SOUND RECORDING REPRODUCTION AND PROJECTION
A Chalmers Publication

PROJECTION
As You Must Know It

This 5th edition HANDBOOK OF PROJECTION by F. H. Richardson is known the country over. It has been the means of making thousands of projectionists masters of their profession. Remember, Richardson gave the "operators" of 1910 the first projection manual ever written.

Now 3 Volumes

Over 1,400 pages of the most vital kind of information. More than 400 illustrations. Each volume carries the special Richardson question and answer index—the greatest feature any projectionist could wish to have.

If your future is linked with projection make it brighter and securer by owning and studying this finest of projection libraries.

The complete set of three volumes mailed to your door upon receipt of check or money order for $10.25.

Special sales representatives appointed by the Chalmers Publishing Company, publishers of the Handbook on Projection. - - - -

MANCALL PUBLISHING CORP.
7 West 44th Street New York City

Fit the Screen to the Theatre

(Continued from page 20)

determining screen reflectivity in one direction is to read the reflection factor from a reflection gauge at that point where the brightness of some part of the gauge matches the brightness of the section of the screen between perforations, then deducting the loss of light caused by the presence of the holes. This loss is usually in the neighborhood of 6 to 10 per cent. The advantage of such a measurement is that it can be made without the projector in operation, the house light or even a portable lamp being sufficient. The reflection gauge is a small disk having a graduated scale of reflecting portions ranging from approximately 0.05 to 0.85.

None of the above-mentioned methods is readily applicable to determinations of reflection factor of the specularly reflecting screens, such as metallic or beaded surfaces. For these types of screens, reflection factor measurements should be made in accordance with regularly established methods.

Direct Reading Illuminometer

Selecting a Screen.—Choice of the type of screen to employ in a theater will depend somewhat on the shape of the theater. For wide houses, in which wide distribution of light is required, the diffusive type is recommended as most uniform. For narrow houses the choice will depend on whether or not a balcony is present. It is seen from the curves shown in a previous report[1] that the beaded screen directs a large portion of its light back into the projector. In this way, the balcony is favored somewhat at the expense of the orchestra. A metallic screen would favor the orchestra. Both these last screens would favor seats on the screen axis, penalizing those at the side. They would also exhibit a lack of uniformity of brightness from top to bottom and side to side and a projected picture would exhibit "fade out" across the screen. In a theater of small width and height this drawback may be outweighed by the advantage of concentrating the light on the axis, without diffusing it to the side walls.

The main optical considerations in choosing a screen are efficiency of reflection, distribution of light at the angles of observation existing in a theater, uniformity of brightness

(Continued on page 33)

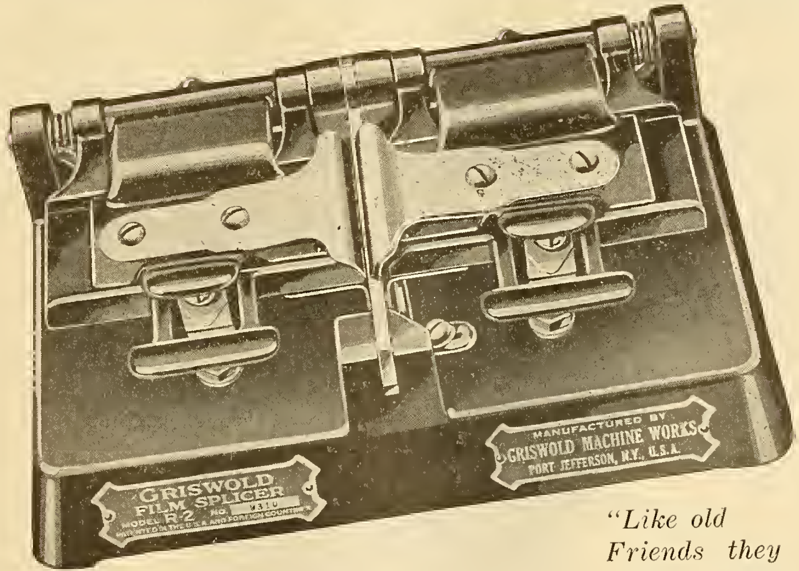
Announcing
85 Ampere 9 x 20

IMPROVEMENTS in the 9mm x 20 inch National "High-Low" White Flame Projector Carbon permit operation at arc currents up to 85 amperes.

LONG LIFE
STEADY BURNING
EVEN CRATERS

feature the performance of this inproved carbon . . .

NATIONAL
PROJECTOR CARBONS
NATIONAL CARBON COMPANY, INC.
Carbon Sales Division · Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices:
New York Pittsburgh Chicago San Francisco



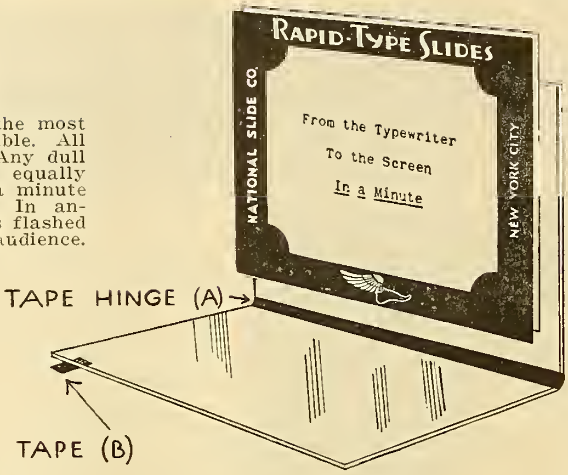
GRISWOLD FILM SPLICER MODEL R-2
MANUFACTURED BY GRISWOLD MACHINE WORKS PORT JEFFERSON, N.Y. U.S.A.

"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS
Port Jefferson, Long Island **New York**



A RAPID-TYPE SLIDE is the most flexible screen vehicle available. All you need is a typewriter. Any dull pointed instrument will do equally well. Your message takes a minute to transcribe to the slide. In another moment its message is flashed to the patrons in your audience.

Talk to Your Audience

Used daily for announcing:

Baseball results
Contests
Requests for silence
Songs
Publicity for community drives
Coming pictures
Etc.

Typewriter slides are being used more and more during this period of extreme economy when everyone's main thought is to SAVE MONEY. RAPID-TYPE SLIDES tell your story just as accurately as a trailer and very much more cheaply. Make announcements from your screen with a minimum of effort and expense, and a maximum of speed and efficiency.

We live in a hectic world. Great news events move upon us minute by minute. Now it is a round-the-world flight. Next minute it is a great earthquake, a revolution, a big man dies, a sudden change in government, a sensational murder, the local ball team wins—or loses—this is the stuff that grips your patrons. Snap up your show with up-to-the-minute news. Give it to them red-hot as it flashes into your town.

A RAPID-TYPE SLIDE can be used in a hundred different ways. - - -

Snap Up Your Show

With

RAPID-TYPE SLIDES
manufactured by
NATIONAL SLIDE CO.
NEW YORK CITY

From the Typewriter *To the Screen*

Ask your nearest theatre supply dealer or write direct to

NATIONAL SLIDE CO., 7 West 44th St., New York City

Another View of Color Photography

(Continued from page 8)

method may be using a chemical or aniline dye with which to tone the positive films. Each of the subtractive processes requires 50% to 150% more light for a proper exposure of the negative than is necessary for the production of a similar black and white negative. This, of course, means intense heat on the sound-proof and practically air-tight sound stages on which most of the scenes for talking pictures are set.

Owing to the double printing and double coating of emulsion of the positive stock the printing of the sound track on a subtractive process film is quite a complicated and laborious task.

The use of the subtractive process means greatly increased production costs, such as more light, expensive camera equipment, double negative stock, double coated positive stock and a very expensive manufacturing technique in which the waste, due to the predomination of one of the two colors caused by over-dying of the red or the green-blue picture image, is very great. I am told that approximately one print out of four is discarded at the final inspection.

It is in the very nature of the subtractive process that the prints obtained are poor in color, being only two color processes they lack definition and clarity. The lack of definition is chiefly due to the superimposition of the two partial images: red and bluish-green and the use of the double coat of emulsion accounts for the lack of transparency of the print.

Technicolor's "Lithographic" Process:

This lithographic process was the one used in connection with the production of "Whoopee," "The Manhattan Parade" and "Doctor X." It is far from a strictly photographic process. Its various operations may be described as follows:

A panchromatic negative is exposed in the special camera described hereinbefore, which results in the registry of the red values on one frame and the bluish-green values on the adjacent frame. Fig. 10. Since the color values of the photographed scene are separated upon two picture frames, the negative obtained is exactly twice as long as similar black and white negative films would be. The negative after exposure is developed in the usual black and white manner. From the negative all of the images representing the red color impressions are printed with a special printing apparatus onto a strip of positive film. After all of the red picture images are transferred to a separate film, all of the images containing the bluish-green picture impressions are then transferred to a second strip of film. These two films are the so-called "master negatives." From each of these two master negatives a printing matrix is made by printing the same upon a strip of film which is then developed and subjected to a certain chemical treatment which raises and hardens the silver deposit in a fashion which closely resembles a photo-engraver's printing plate.

With these two matrixes ready, a blank strip of celluloid is covered with a layer of gelatine which is color absorbent. Then the matrix containing the red impressions is dipped into a red dye solution and applied like a printing plate to this blank strip of gelatine covered celluloid. During this operation of transferring the red dye from the printing matrix to the gelatine layer, both the matrix and the gelatine coated strip of celluloid must be held together very rigidly by a mechanical contrivance to prevent "blurring" of the image. After the red parts of the image are impressed or "imbibed" on the gelatine coated celluloid, the same process is repeated with the matrix containing the bluish-green impressions of the scene photographed. This matrix is soaked with a bluish-green dye solution and imbibed on the gelatine layer directly over the color which has already been imbibed from the red image. The gelatine layer is now interpenetrated with both dyes—red and bluish-green —in exactly the same proportions that those colors with their varying shades existed in the scenes photographed originally.

While this lithographing process may not be simpler, less expensive or more fool-proof in its operation than the other types of the subtractive method, it does permit greater transparency of the finished product and does away with the many shortcomings of the double coated positive stock besides being less affected by scratches of the projector. Which of my readers has not asked himself about the red and green "rain" that appeared on a double coated film after several projections? A scratch on a black and white film, on a Wolff-Heide Film or on a Technicolor lithographic process leaves the scratched surface blank, while on double coated films the scratch removes the color from the scratched surface on one side but not on the other side and the result is a red and green colored "rain."

Experts on both sides of the Atlantic frankly admit that none of the existing "additive" or "subtractive" processes is a satisfactory solution to the problem of motion pictures in color. In fact, we may as well admit, that the existing processes are far too complicated and expensive to permit their adoption under the present financial condition of the producers of motion pictures, nor can we shut our eyes to the fact, that the quality of the majority of color productions released so far was not such as to find enthusiastic reception among the audience. The only features in color

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

It is no exaggeration to say that our rheostat is internationally famous.

Four out of every five theatres in this country use **Hoffmann-Soons Rheostats** ***exclusively.***

A first class product, backed by reputation and guarantee. It always leads the field.

Now equipped with solderless, adjustable lugs ta take wire sizes from No. 4 to No. 4/0 without any additional cost.

THE ONLY UNION MADE RHEOSTAT

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Specialists

RHEOSTATS

SUN-ARC CARBONS

for

PERFECT PROJECTION

"BEST BY TEST"

Big Savings—Complete Satisfaction

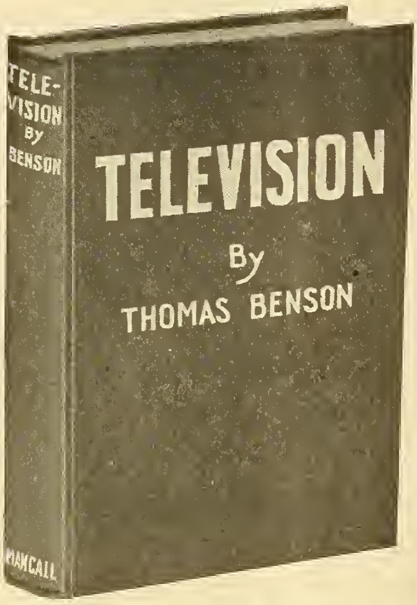
Casco Carbon Saver for Hi-Low and Hi-Intensity carbons, FREE OF CHARGE. Permits the burning of carbons down to 2 in. and less.

Carbons furnished *ready for use.* No inconvenience whatsoever for the operator.

Samples on request. Address

CARBON PRODUCTS, INC.
324 West 42nd Street New York City

BE PREPARED!



TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today.

NOW
$1.00
Final Edition
Only Few Copies Left
ORDER IT TODAY

Some of the Contents

- Elements of Visual Communication
- Light Sensitive Cells
- Scanning Methods
- The Television Signal and its Amplification
- Transmission Channels for Television
- Light Sources for Television Reception
- Reproducing the Image
- Synchronizing Methods
- Stereoscopic and Color Television
- Experimental Television

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th St., New York City

Enclosed find money order for $1. Please send me Benson's Television.

Name..............................

Address..............................

City and State......................

Theatre..............................

that we may consider as closely approaching the ideal in color cinematography were some of Technicolor's productions such as: "Whoopee" and "The Manhattan Parade." The development of the Wolff-Heide and Troland processes is expected to change this situation in the immediate future.

The Wolff-Heide process incorporates all of the good qualities of the additive and subtractive processes and eliminates all of their respective shortcomings. In fact, I consider the Wolff-Heide process as the final solution to the problem of color photography.

Wolff-Heide begins with the theory that the basis of all photography is blackened silver and therefore the obvious answer to the question of "how to get colors" is the conversion of the blackened silver deposit on the film into its respective colors. And he did succeed in doing just that without the highly complicated manufacturing technique of the "subtractive" principle or the intricacies of the "additive" methods.

From the information submitted to my readers heretofore, they undoubtedly realize that all "additive" and "subtractive" processes, after they obtain their separate color negatives employ either complicated optical lens systems, double coated positive films or lithographed prints to obtain colors. The Wolff-Heide plan is a distinct departure from the above schemes. In this process certain colloidal chemical principles have been put to work that produce the desired results, namely: the conversion of the silver deposit into its respective colors photochemically and not "optically" or by way of complicated printing methods.

Wolff-Heide has taken advantage of the fact that certain dyes like pinasyanol are colloids and do not penetrate gelatin except after tremendous effort. These dyes have the peculiar property of making an ordinary blue sensitive film, sensitive also to the red, green and orange colors.

If he bathes an ordinary piece of film sensitive only to the blue rays in a solution of these dyes, they will penetrate very little into the film. Thus he divides the layer of the emulsion so that the bottom of the film is blue, the middle is green, while the upper part where the solution has penetrated, is orange and red sensitive. Fig. 11.

If he photographs upon this film, the bottom will contain the blue partial image, the middle part the green impression and the upper part will contain the red and orange impressions. If one subjects this film to microscopic tests one can actually see three distinct images, one above the other. The camera used is the ordinary black and white camera. Everything in the exposure of the negative and its development remains the same as in black and white motion picture work, the separation of the colors coming automatically because of the previous chemical treatment of the film, which permits the selection of the colors in their respective parts of the emulsion.

This "selective" sensitizing is the real value of the process and represents the final step toward the ultimate in color photography, i. e. photographing all colors on the same film with the same effort as is used at present for black and white purposes.

After the film is exposed it is developed in the same fashion as a normal black and white negative. The film is then passed through a chemical bath which converts the silver deposit in the upper part of the layer, the red impression, into its own colors: red and orange. Leaving the red bath the film then passes into the second, a green bath, which converts the middle portion of the layer—containing the green impressions—into green silver and from there the film passes to the third and final chemical bath which converts the silver deposit on the bottom layer, representing the blue impressions, into the blue color. Less than ten minutes are required to subject the film to pass through these three chemical baths.

The colored negative now obtained is then printed unto a positive film similarly treated for selective color separation as the negative film. The processing of the positive print is then an exact duplicate of the negative described above, and the result is a single coated, clear and sharply defined picture which contains all the colors of the original subject photographed.

Besides the four chemical baths to which the negative or positive film is subjected in accordance with this process all other operations remain exactly the same as in black and white film work and for this reason the cost in connection with the use of this process remains practically the same as the black and white process. Such difficulties as registry, color flicker, color fringes or "over-dying" of the partial images as exist in the "additive" and the "subtractive" methods are eliminated from this process. As far as the work in connection with the sound track is concerned the process offers the same facility and simplicity offered by black and white film work.

The "shooting" of the negative in the studio requires the normal black and white light conditions because there is nothing to obstruct the passage of light through the lens to the film as is the case in the "additive" or "subtractive" processes which use either a complicated lens, prism or filter system and instead of using two or three film frames for negative purposes to obtain one complete image, as is the case in the "additive" and "subtractive" processes, this process using only one frame and thereby

(Continued on page 33)

FIT THE SCREEN TO THE THEATRE

(Continued from page 29)

across the screen as viewed from various points, and invisibility of seams. To be quite satisfactory, a screen must fulfill the requirements imposed upon all these properties and, in addition, must fulfill requirements directed toward ease of maintenance, sound transmission, and mechanical properties. A screen with the highest initial reflection is not necessarily the best from the optical standpoint. Reflecting ability must remain good over a period of time under such conditions as may exist in the field. The pigment and vehicle composing the surface should meet the specifications outlined above. A hard, smooth surfaced screen would be easiest to clean and less apt to collect dust but, on the other hand, may not be so uniform in its distribution of light. No tendency toward glossiness must be present, as it would be likely to cause the seams to be prominent and mar a projected picture by dividing it into vertical sections.

As regards acoustical properties, a screen should be of a type approved by manufacturers of sound equipment, as stated in a previous report.[1] In general, the lighter the material used for the screen, the better it will transmit sound. There are many screens among which there is little to choose as regards sound, many being made from the same or similar basic fabrics. As the weight per square foot is increased, sound transmission is less efficient, especially at the higher frequencies.

From time to time, there has been exaggeration in statement made by individual manufacturers concerning the superiority of their product. Screens have been claimed to remove distortion, create three dimensional effects, and heighten illusion. The Committee would like to go on record, stating that there is little or nothing to these claims. A picture projected on a plane screen when viewed from an angle will appear foreshortened horizontally, and the type of reflecting surface on the screen will not alter the situation; if projected at an angle, the figures will be further elongated. As for stereoscopic effects, it is impossible that a flat surface, reflecting pictures made in the ordinary manner, will reflect anything but two dimensional views, and in any case only what is projected upon it. Judging from recent papers on the subject, three dimensional projection is possible only with special prints and probably special projection or viewing apparatus. A screen has no power to differentiate between background and foreground objects, influence their relative position, or produce binocular vision from monocular photography. Its quality must be judged by the nature of its reflecting surface (of course, also, by mechanical, acoustic, and maintenance considerations, these being extraneous to this particular discussion). As for illusion, a screen, that reflects an image that can be comfortably observed, will probably be said to heighten illusion in the sense that it does not cause distraction.

Rear Projection Screens.—As yet, the Committee has not been able to obtain a release for data on the light transmission properties of rear projection screens. There are relatively few manufacturers in this field, and they are unwilling to release information more detailed than what has already been published.

Screens for 16 Mm. Projection.—The requirements for 16 millimeter screens for home or demonstration use are not as severe as those for screens for theater use. They are usually metallic or beaded, in order that great values of brightness may be obtained over a limited area, immediately in front of the screen. The sizes vary from 22 by 30 inches to 9 by 12 feet. They are made to be rolled into convenient wooden or fabrikoid cases.

Color Photography

(Continued from page 32)

saving substantial sums of money on film material alone.

Another interesting advantage of this process is in the fact, that by leaving the three dye baths away the film may be projected as a normal black and white film and the "selective" color separation which has been created in the upper, middle and bottom part of the emulsion will become apparent in the projection only through a much wider scale of the "gray" gradation than is usually the case in black and white productions which greatly enhances the artistic effect of the projection.

Dynamo Troubles

(Continued from page 12)

are made of heavy bars secured to end rings. Where these bars connect to the end rings is where the trouble starts. The *best* modern motors are either jointless or the joints are made by welding, brazing or silver soldering. Where the joints are so made trouble almost never develops in such rotors.

Where the joints are made by riveting, or by screws as was common practice a few years ago, they eventually become oxidized and while the joint may seem sound and good to look at, it is really so nearly "open circuited" as to be useless.

Where the joints have been soft soldered an overheating of the rotor will cause the solder to first throw out and eventually to oxidize in the joints.

Such rotors should be welded with copper if the bars and end plates are pure copper with no solder, or brazed if of brass or if they have been soldered with soft solder.

There is another class of rotors whose bars and end rings are usually cast entirely of aluminum. Owning to the fact that aluminum gets weak and comes apart when it gets heated to about 600° F., these rotors sometimes "open circuit." They may look good, but the load and noise test will tell the story. They cannot be repaired.

Noiseless Recording?

(Continued from page 13)

slit, the movement of the filament due to vibration causes a varying light source which must be avoided. Of course on some optical systems, a visual adjustment can be made which is satisfactory when the image of the filament completely covers the slit, the edges being sufficiently clear of the slit itself but this is not always possible so the above adjustment, while the machine is running, is suggested as an easier method to reduce exciting lamp noise and keep our systems quiet for noiseless recording productions.

ANNIVERSARY ISSUE

THE October issue of the MOTION PICTURE PROJECTIONIST will mark the beginning of the sixth year of publication of this nationally-accepted magazine on projection.

To mark another milestone, the October issue will be special in many ways. It will not only review important advances in the craft during the life of this publication but will carry a variety of important articles especially prepared for this issue.

A Service Engineer Makes His Rounds

(Continued from page 28)

Spares

Upon the back wall of the booth is located a small metal cabinet, Smith is making his way to it. This cabinet contains the spare parts such as photo electric cells, small tubes, fuses, and other items. The cabinet must always contain its full quota of parts. Smith therefore checks the contents of the cabinet against a list which he carries. If the cabinet is short a certain piece of equipment it is checked on his list as a memo to be referred to the manager's office for replacement.

Back Stage

Smith has now completed his routine inspection in the projection room. He is ready for the horns and so proceeds to "backstage." Once there he quickly tests each horn by pulling all the horn field switches and trying them one at a time to determine whether or not they are operating. A glance at the horns and the cables reveals their general condition.

Completion

Having completed his inspection of the equipment Smith takes a seat in the theatre auditorium to listen for any possible defects which escaped his notice during the inspection.

He listens to the opening overture of the performance and the first two reels of the picture.

Smith is satisfied with the fruits of his labors and decides to listen to several reel of the feature picture when an usher addresses him quietly and informs him that his home office waits on the telephone. Some theatre is in trouble.

(To be continued)

WATCH
for special Anniversary
Issue of
MOTION PICTURE PROJECTIONIST
OCTOBER 1st

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO., 844 So. Wabash, Chicago.

Projection in Photography

(Continued from page 22)

a plane by transmitted light which is superior to that of an image photographed by reflected light.

These two generally described transparency processes are not primarily trick processes. They have their uses, of course, in this field, for with them many added effects are possible which could not alone be obtained by the use of miniatures, optical printing, or any of the established travelling matte or other trick processes. But this use is, to my mind is, of only secondary importance. The prime value of the transparency processes lies in their utilization as a supplement to normal cinematography. Transparency cinematography can be used to secure many effects actually possible by ordinary methods; but its chief advantages, however, lies in the fact that frequently it will secure these effects better, more quickly, and more easily than by straight-forward cinematographic methods. By its use, time, effort. personal risk, and money are saved, and the desired effects can be obtained with more absolute control than by straight cinematography.

The technical requirements for both these methods are simple but exacting. In the first place, the original background negative must be photographed from exactly the right viewpoint and angle to give the final composite scene the desired perspective. They must, moreover, be photographed with a camera which is rock-steady and free from all optical or mechanical aberrations. They must be photographed especially for this work; ordinary production or stock shots are generally unusable for backgrounds owing to weave and movement caused by them in the completed shots.

As the original backgrounds are to become dupes in the final result, it is necessary to photograph them with a negative emulsion producing a minimum amount of grain size, yet adequately retaining proper black and white balance and rendition of the whole scale of color values.

Once photographed, the negative, for best results, must be given special development to produce a minimum of grain size, and held rigidly to exacting standards of gamma and density control, then dried slowly at a moderate temperature to produce the least amount of shrinkage. The background prints require equally as exacting care and control in regard to development, gamma, density, perforations, shrinkage and handling.

A summarized comparison of the merits of the two composite processes reveals that the color method has a larger scope as to size of shots obtainable, over those of the projection method. The problem of perspective is not nearly as difficult with the color method as with the projection method. The ability to do dual roles—shooting down or up angles or falling shots is much simpler by the color method than by projection. On the other hand, the problem of normal black and white lighting used in projection is simpler and more easily handled than the special complementary lighting of the color method. The problem of preparing the backgrounds to be duped is simpler in projection than in color. The ability, to a limited degree, to move the camera about the set on a projection shot is a distinct advantage, whereas, the camera must remain stationary on the majority of color method shots. Projection is faster to operate than the color method and also the problem of make-up is not so exacting as in color.

It is, therefore, readily seen that each method has its own distinct advantages—the type and scope of the finished shot requires determining the system to be employed.

Our present day photographic technicians are outstanding in their resourcefulness and versatility. They have the ability and capacity to be one of the industry's greatest economic assets of the future. Their ability to combine the real with the fictitious, maintaining precise and critical realism, is amazing. Their adequate understanding and appreciation of the dramatic, artistic and economic values in combining a photographic process embodying mechanical and illuminating engineering, places the special process branch of the cinematographic profession in an unparalled position.

(Concluded in next issue)

Sound Head Troubles

(Continued from page 23)

result. However, there will be no loss of sound.

Dirt in the sound gate is a frequent cause of extraneous sound in reproduction of sound in theaters. A piece of lint left in the sound gate after cleaning the sound head may vibrate back and forth across the path of the light beam and thus cause grating noises in the sound reproduction.

While none of the problems discussed in the foregoing are novel or original in nature, they nevertheless cause a good deal of trouble. They are more or less inexcuseable because their elimination does not depend on any thing more than observation and common sense. Complicated electrical troubles in the equipment may call for work by a service man but there is not much excuse for a service man having to do things than can best be done by the projectionist. A well-kept sound head eliminates much poor sound and very often prevents many an "outage."

THIS
BOOK
IS
A CHALLENGE TO EVERY PROJECTIONIST IN AMERICA

More Miehling books have been sold to projectionists than any other. . . . There have been others since Miehling's book was brought out . . . and all at a higher price . . . but Miehling's still remains as the only book written by a projectionist for projectionists. . . . That is why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of ALL sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

NOW ONLY

$2

SOUND
PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer, of sound equipment and practicing projectionist.

•

**519 pages . . . .
Completely indexed
Fully illustrated.**

Do Not Delay! Fill in this coupon and forward to us at once with your remittance. Do it now!

MOTION PICTURE PROJECTIONIST
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $2.00.

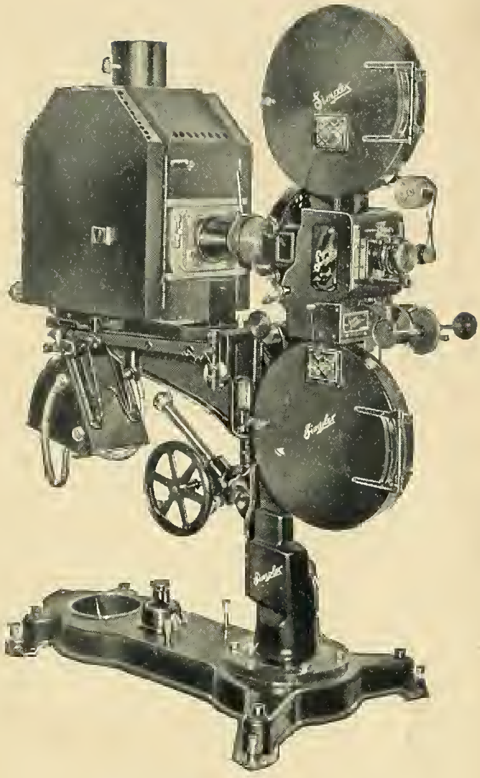
Name..

Address..

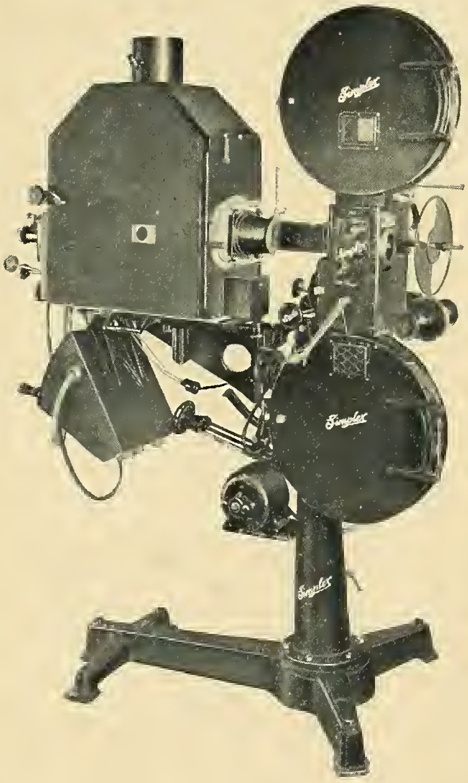
City and State...

Position..

Theatre...



Simplex MODEL R
PROJECTOR



Simplex REGULAR
PROJECTOR

"NEGLECT IS FALSE ECONOMY"

REAL ECONOMY—

IT PAYS TO USE

Simplex
TRADE MARK REG'D.

PROJECTORS

IT PAYS TO KEEP
YOUR PROJECTORS
IN GOOD REPAIR
AT ALL TIMES

WITH

GENUINE

Simplex
TRADE MARK REG'D.

PARTS

SEND FOR BOOKLET DESCRIBING
Simplex-Acme SOUND PROJECTOR

INTERNATIONAL PROJECTOR CORPORATION
90 GOLD STREET
NEW YORK

MOTION PICTURE PROJECTIONIST

IGNORING A POWERFUL INFLUENCE

IN a recent paper by Mr. Francis M. Falge published by the Society of Motion Picture Engineers there occurs the following significant statement:

"The projectionist . . . is answerable to the manager for problems connected with the picture. The projectionist . . . is trained and equipped to assume direct responsibility for all problems pertaining to the picture, whether inside or outside the booth. His familiarity with the principles of light control and of the mechanical details of operation is needed to decide what carbons should be used or what screen should be installed."

There was more. But enough has been cited to indicate an awakening recognition of a flaw in the sales psychology of those who produce and market projection equipment.

SEP 28 1932

All stress is laid on the manager; hardly any on the projectionist.

They forget that the manager has many problems among which projection is but one. With the exception of a few managers, most of them are more concerned with the price of projection equipment than with its quality. For quality he must look to the projectionist. It is in the high reaches of the projection room where many a sale is made or lost. The projectionist may be entirely unseen but his influence is powerful.

Equipment manufacturers, as a rule, have ignored the projectionist in their sales promotion.

There is too much effort on sales; too little to understand an industry—and thereby sell more.

Boone Mancall

FIFTH YEAR *of* **PUBLICATION**

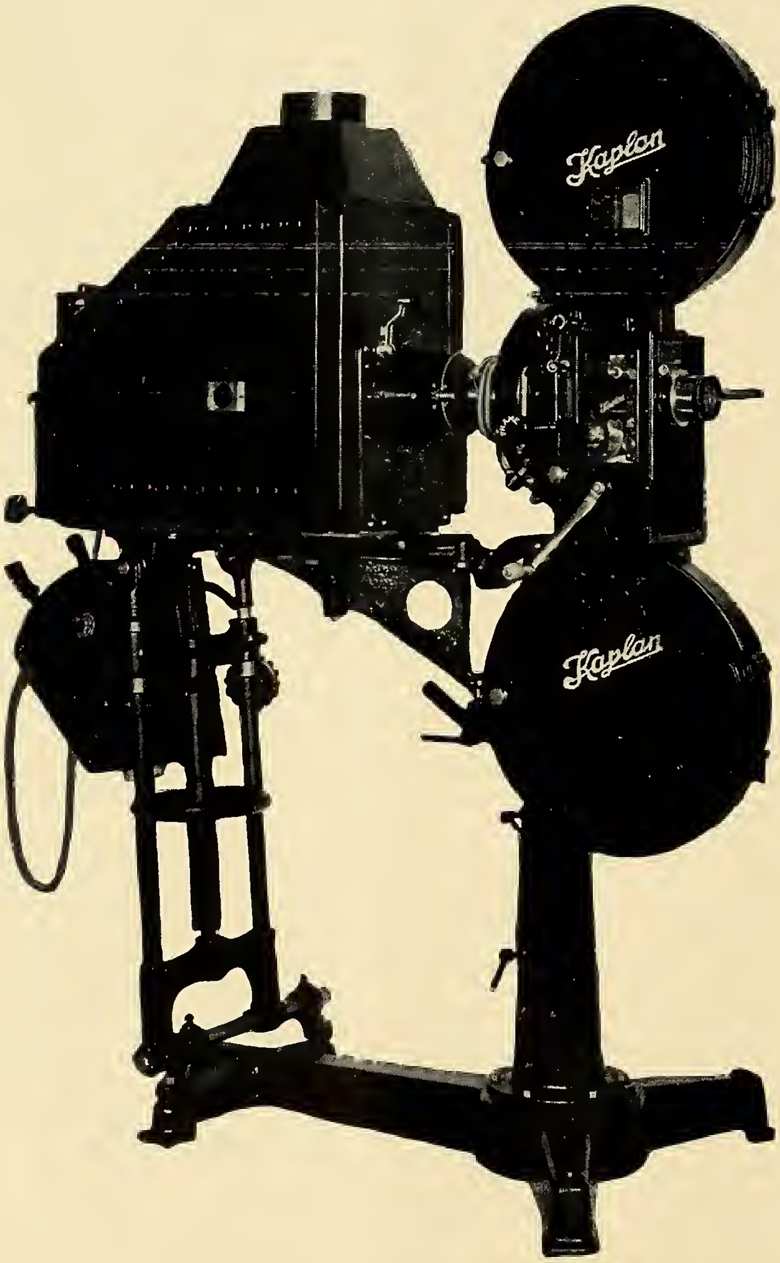
Published by the MANCALL PUBLISHING CORP., Boone Mancall, *President.*
Editorial and Advertising Offices, 7 West 44th Street, New York City.
Entered at New York Post Office as second class matter, October 25, 1927.

Vol. 5 ▾ No. 11
September, 1932
25c. per copy -:- $2.00 per year

AROUND WITH THE SERVICE ENGINEER
IN THIS ISSUE.

Kaplan

PROJECTORS



Widely used in this country—known internationally, the Kaplan Projector is universally recognized as a product of the first rank. It has earned its reputation because it is designed and built on the best engineering principles.

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 Seventh Avenue New York City

MOTION PICTURE PROJECTIONIST

September, 1932 Vol. 5, No. 11

EDITORIAL BOARD

BOONE MANCALL, *General Supervisor*; LESTER ISAAC, *Efficiency*; J. H. KURLANDER, *Light*; J. E. ROBIN, *Equipment*; W. W. JONES, *Theory*; HARRY RUBIN, *Improvement*; VICTOR WELMAN, *Personnel*; SIDNEY BURTON, *Production*.

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue.

Entered as second class matter October 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth Street
Melbourne, Australia.

Editorial & Advertising Offices
7 West 44th Street
New York City.

National Advertising Manager
Boone Mancall

OUR PLATFORM

To maintain always the integrity of the original policy of this publication: that it be a means of raising the standards of projection by a ceaseless campaign of education among the many thousands of projectionists in the United States and Canada.

That every available inch of space in each issue be devoted to this end.

That we be interested in neither the politics or the personalities involved in the politics of the International Alliance of Theatrical Stage Employees and Moving Picture Operators or of any other group or body of projectionists, because such interference with internal affairs of labor organizations will make this a partisan and political paper and destroy its value to the craft which lies in educational work only.

That by maintaining our policy of education we will enjoy the support of projectionists everywhere for many years to come as we have enjoyed this support for the last five years as the leading projection publication in the country.

The Editors and Advisory Editors and the organizations with which they are affiliated do not necessarily endorse all the statements or opinions offered in this magazine. The author who signs an article assumes full responsibility for the statements it contains.

NAMED FOR THE NOISE

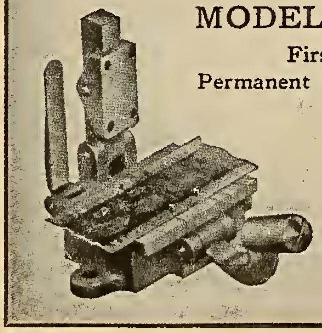
THEY ELIMINATE

PROJECTIONISTS and laboratory workers refer to Eastman Sound Film Patches as "bloopers." But these patches don't "bloop." They *eliminate* the annoying, booming sound that would be likely to result from a painted-out splice. What's more, they do it quickly, accurately, and without the muss and bother that accompany the older method. There is a right way to splice sound film, and it requires only the purchase of these ingenious Eastman patches, plus the precise registration block designed for them. You can have both at a nominal cost ($5.00 per thousand for the patches, $4.25 for the block). Eastman Kodak Company. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

EASTMAN

. . . SOUND FILM PATCHES

Universal Film Splicing Machine



MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film

Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

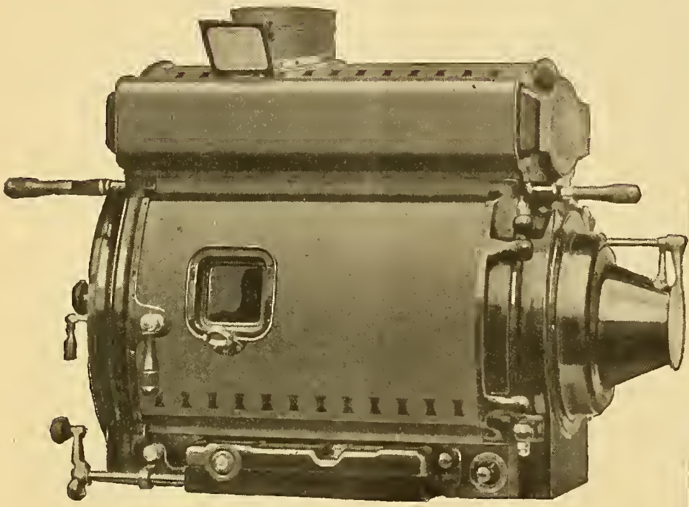
Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.

For sale by all Supply Dealers

The New Brenkert

High Intensity Reflector Lamp



Air-cooled mechanism — Plain negative carbon — Oil lubrication to all bearings — Pyrex mirror reflector — 65 to 85 amperes capacity — unit construction — and many other features assuring excellent screen results, ease of operation and low maintenance cost.

Distributed by Independent Supply Dealers

WRITE FOR LITERATURE

A Brenkert PRODUCT

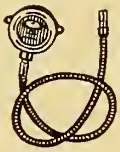
CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

...Yes, sir

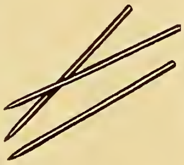
you'll always find what you want at NATIONAL

There's a lot of satisfaction in being able to walk into or call up your supply house and GET WHAT YOU WANT—right when you want it. To be told "we'll get it for you in a few days" isn't quite so satisfying. National stores are stocked to serve you in a hurry.



Speed Meters

Precision devices of all kinds for clocking speed and testing projection and sound apparatus. Tell us your need. We have it.

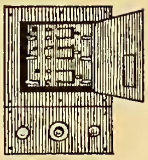


Carbons

Projector carbons of all sizes are amply stocked at National stores. Standard and special sizes are available in any quantity.

Splicers

Film splicing and patching devices of the very latest approved type to suit every need are provided for you at National.



Panelboards

Special and stock types to meet every projection room requirement for efficiency and space saving are quickly available at lowest prices.

Lenses

The world's finest domestic and foreign made projection lenses in all focal lengths are supplied by National.

Ask about our FREE Equipment Inspection Service. It avoids trouble and saves expense.

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

AS I SEE IT

¶ Pay Cuts

A FEELING of depression, lurking deep in the human heart, seems to have taken hold of projectionists everywhere. There is ample justification for it because the economic situation of the country has touched their lives and left misery and hardship in many homes. Looking into the future where they hoped to find a cessation of wage-cutting and perhaps a rise in their earnings, they now see only further wage cutting and no prospect of a change for the better. It is not a pleasant situation for anyone to contemplate. Human beings bear the slings and arrows of the present if only they can lift up their faces to the golden promise of a new day. But there is talk of a winter of hardship and the end of these gloomy times seems so far away.

There is no group of men in the motion picture industry that deserves more from it than the great body of projectionists. In the light of their achievement in the recent years and their importance in the theatre, they are being treated rather shabbily. The constant warfare waged upon them by exhibitors to reduce their wages is not merely an exhibition of ungratefulness but a short-sightedness that must have its repercussions in the years ahead.

These men who have taken one, two and three wage reductions and who are now being asked to take further cuts are the same men who accepted the new science and the new equipment of talking pictures and delivered a splendid performance. They are the same men who bear day and night a many-sided responsibility. They not only bear the burden of maintaining expensive and delicate equipment in a high state of efficiency and of delivering a good show but they have the lives of millions of men, women and children to protect during the strenuous hours they spend in the projection room. It is heavy responsibility that cannot be measured in terms of the unskilled laborer.

There is not a city or village in the country that does not witness today a battle between projectionists and exhibitors over wages. Without regard to skill or responsibility exhibitors are asking for more and more pay cuts and it is difficult to see where it will lead to. One thing is certain: projectionists are too honest and too proud of their work to retaliate by a lowering of efficiency or a let-up in their vigilance for the safety of the innocent people in their theatres. But it will leave a deep wound.

One of the biggest theatre circuits, after having asked and secured several pay cuts from its projectionists, is now said to be asking for another. Their men are already back to pre-sound wage scales and in some cases even below that; this last reduction if granted will set them back to the early years when projectionists were fighting for a little more than a bare living wage.

At the same time this particular circuit is crowded with executives whose weekly pay envelopes would support several large projectionist families in comfort. It is true that these executives have also taken reductions but it has by no means forced a compensating reduction in their scale of living as it has in the case of projectionists.

I think no one will deny that every man, regardless of his station in life, socially and economically, is entitled to food, shelter and clothing, along with some of the comforts of a civilized life and the opportunity of giving his children a decent schooling.

It seems to me that the provision of these simple requirements is the deep responsibility of those who have it in their power to regulate (by salaries) the lives of hundreds of their employees. In this case it would seem logical and just that reductions in their organizations be made more equitable: take more from those who do not need so much, take less from those who need more.

The best minds in this country are certain that a thorough-going revision of the mental attitude of the employing class will have to be made as a result of the unprecedented misery which after all is not an act of God but a symptom of economic mismanagement. Such a revision could best start with a sympathetic understanding of him whom Governor Roosevelt has so aptly termed "the forgotten man."

The projectionists of the country are fighting for a little more than food, shelter and clothing. This publication is with them in this fight.

¶ How Soon?

IT is heartening to witness the unabated interest among projectionists in new projection equipment and in laboratory developments that may lead to new designs.

Although the excitement aroused by talking pictures has died down, and equipment more or less stabilized, there is still a great deal of independent investigation going on. Working quietly in his Auburn laboratory, Case developed Movietone. Who knows what unknown may not hurdle the last obstacle to Television, or stumble upon the secret of third dimension? Projectionists will be the first to welcome such news.

B. M.

Give the Projectionist Good Equipment

BY FRANCIS M. FALGE

UNLIMITED time and money are spent in improving, usually to a small extent, the many aspects of projection until, at length, the screen is taken into consideration. Here we stop; and yet, it is a fact that an improvement in projection of 100 per cent could be realized by making the appropriate corrections of the screen conditions. Not only would a large saving in electric current be achieved, but an improvement in box-office receipts would also be realized because of the better appearance of the picture, and the improvement as regards visibility of the picture and the attendant strain on the eyes.

In the average American theatre, the manager, whether employee or owner, assumes full responsibility for all details of operation of the theatre. Various departmental subdivisions are made, one of the most important, if not the most important, being the department of projection. The management sees that the proper film is delivered to the theatre at the proper time, purchases such equipment as is needed for projection of the picture, and relies on the department of projection to coördinate all details in such a manner as to assure the best picture.

The projectionist, then, is answerable to the manager for problems connected with the picture. But how far does this go; where does his authority cease? An analysis of the facts shows that the projectionist is trained and equipped to assume direct responsibility for all problems pertaining to the picture, whether inside or outside the booth. His familiarity with the principles of light control and of the mechanical details of operation is needed to decide what carbons should be used or what screen should be installed.

The proper presentation of pictures, however, does not end with the placing of the responsibility on the projectionist. He must be provided with technically good film, of the proper density, and in the proper condition. Furthermore, his equipment must be in a satisfactory condition, and especially his screen must efficiently reflect the picture to the eyes of the patrons. Properly backed up by the manager, there should be no reason why a projectionist, with full responsibility for projection, should not have a picture at all times that is a real box-office asset.

It is a rule, rather than an exception, that the theatre or maintenance manager of one or more theatres has, in discussing screens, said that he knew they were in a very bad condition, but that the condition of the business would not permit him to spend money now. Therein lies a fallacy, and a good reason why business is not so good. Furthermore, profits are lowered because a dirty or improper screen actually causes a waste of money.

Too True!

"An analysis of the facts shows that the projectionist is trained and equipped to assume direct responsibility for all problems pertaining to the picture, whether inside or outside the booth. His familiarity with the principles of light control and of the mechanical details of operation is needed to decide what carbons should be used or what screen should be installed."

Thus says a member of the Society of Motion Picture Engineers. It should be broadcast to the entire industry.

We are indebted to the Society for the reprint of this article.

A careful study of this situation has shown that the only method of correcting this unfortunate state of affairs is to face the issue squarely, and to place the responsibility on the proper person, the projectionist. This would result in bettering projection as a whole, and in simplifying the problems of the management.

Some of the facts with which the projectionist should be familiar are as follows:

(1) The selection of the correct type of screen is dependent upon individual theatre conditions, and especially upon the type of lamp, the angle of projection, and the width of the house.

(A) White diffusing screens reflect light about equally in all directions. They are best for wide houses; houses having large projection angles, and using high intensity lamps.

(B) Beaded directive screens redirect light into a beam so that the light reaches a majority of seats in a house suited to this screen. A smaller percentage of light passes in all directions, so that a satisfactory picture can be seen from any seat not directly in the beam. These screens are best for medium width or narrow houses having projection angles under twenty degrees.

(C) Metallic reflective screens concentrate light into a narrow beam, with no diffusing element, and are suitable only for very narrow houses.

(2) When the type has been chosen, the most efficient of that type should be purchased, and it should be the one that will provide the best results throughout its useful life. The reputation of the manufacturer should be considered, and unusual claims should be carefully investigated.

(3) The proper size should be chosen:

(A) Minimum desirable width is one-sixth the distance of the screen from the farthest seats.

(B) Maximum desirable width is eight-tenths the distance of the screen from the front seats.

(C) Intensity of lamps is an important factor in limiting the size.

(4) The screen should be properly installed by following carefully the directions of the manufacturer. It should be masked in dead black. Screens should be placed not less than 18 inches from the stage floor, and as far from the front seats as possible.

(5) The projectionist should take note of the house lighting, and should suggest the elimination of glaring lights near the line of vision, and of spilled light on the screen.

(6) Great care should be taken to keep dust from settling on the screen.

(A) All overheads and maskings should be kept clean.

(B) Doors and other openings that cause drafts through the screen should be kept closed.

(C) A front curtain should close in the screen when it is not in use.

(D) In many cases, it is essential that the screen be backed up to the horns with a non-porous material.

(7) Screens should be cleaned regularly once a week by brushing, by using a vacuum cleaner on the back surface, or by blowing.

(8) If recommended by the manufacturer, screens should be cleaned according to instructions every three to six months, depending upon the local conditions.

(9) For diffusing screens, it has been shown that resurfacing by spraying is possible, though the process is still in the experimental stage.

(10) Screens should be replaced in nine to eighteen months, depending upon the local atmospheric conditions and the care given the screen. Screens constantly diminish in efficiency, and, as a result, the picture constantly grows dimmer. When the efficiency of a screen has decreased about 30 per cent, the cost of the additional electric current is usually greater than the cost of a screen.

To assure that a satisfactory and efficient projection surface is present at all times, it is not only necessary to observe the above recommendations, but to provide for proper inspection of the surface. This should be the duty of the projectionist. At weekly intervals, a white booth light should be projected on the screen and the surface inspected for streaks, clouds, and discoloration. Then a small sample of a fresh piece of material should be placed against the screen and the loss of light estimated. A decided difference should be a warning that the screen either needs brushing, or that, due to age, it has deteriorated beyond the useful economical limit.

Recent tests made by the Projection Screens Committee of the Society show a loss of about 50 per cent in reflectivity of screens after a year's use. This means that with a low intensity arc, 30 amperes produce the results of 15; with a hi-lo, 75 amperes produce the results of 37, and with high intensity arcs of 120 amperes, only 60 are really being used effectively.

Sound screens are porous and act as filters. The air passes through the screen, and the dust and dirt stay on the surface. Moisture and temperature conditions cause the dust to adhere to the surface in varying degrees causing streaks, cloudiness, and discoloration.

Taking a conservative 10 per cent loss of reflectivity for each three months' period, we find that at the end of the year, screens used ten hours a day, with electric power costing five cents per kwh., are causing a loss of light and money as follows:

Lamp Intensity	Loss Amperes	Effective Amperes	Daily Loss	2nd Year's Loss
Low 25 Amps.	7	18	$0.37	$135.05
Hi-Lo 75 Amps.	20	55	1.10	401.50
High 120 Amps.	33	87	1.82	664.30

The second year's loss will be greater because of the cumulative effect on the loss of light.

Good business based on true economy will dictate that a screen that loses more than the cost of a new one should be replaced. The probable loss due to the patron's dissatisfaction with the dim, lifeless picture and its harmful effect on his eyes is even more serious, though less easily evaluated.

The steady progressive decrease in light is constantly compelling the projectionist to devise ways of increasing the brightness of the picture. This is especially true when a dense print is used. Constant forcing of the equipment causes inefficient burning of carbons as well as troubles with the light source; an increase in the cost of carbons; trouble with the automatic feed; trouble due to the increase of heat in the lamp house, especially in the reflectors, condensers, and meters. Furthermore, the feed lines may not be capable of carrying the larger load, and trouble and loss may result from this cause. All this can be eliminated by keeping the screen surface in good condition at all times.

On the Optical System

WHEN an optical system is received from the manufacturer it usually has a thick coating of grease on all the unpainted metal parts so as to prevent rusting while in transit. Before installing the new system be sure to clean both the shoes and the surface which is screwed to the sound head. Should any dirt or thick grease become lodged between the optical system and sound head the system would be at an angle to the film travelling downward other than right angles. In other words, the actual slit of light would not be parallel to the striations of the sound track. Should such a condition exist fuzziness on high-pitched voices and a similar condition to high frequency flutter on sustained notes would be heard.

The most common causes of trouble in the optical system are oil and dirt. It is not necessary to stress the importance of cleaning the exposed lenses on the optical system, and there is seldom any trouble from this source. It is from within the system that trouble occurs. Some oil from the projection head is bound to find its way to the sound head. After months of running a machine oil vapor will in some way enter an optical slit and condense on one of the small lenses. If the oil itself does not trickle into the system then oil vapor will. If the oil condensed uniformly over the entire surface of the lense there would be no apparent indication. However, due to its weight, the oil collects on the bottom of the lense and causes the top part of the light slit on the film to become ragged. This is very noticeable if you remove the light gate and place a white card in its place. Instead of the image on the card being a complete oval shape the upper half is diffused, blurred, or entirely missing. Streaks in the image are another indication of oil. This, however, is not as detrimental to good quality reproduction as a "half-moon" image. Should the system be dirty the image would appear slightly fogged. Dirt will completely prevent the light ray from passing whereas oil detracts the ray and causes the slit to be ragged.

Still another disturbance caused by a faulty optical system is vibration of either the slit or component lenses, which is similar in sound to a microphonic tube. In some cases the exciting lamp filament will vibrate because of gear trains in the projection machine set-up. A more detailed explanation of the vibration of this filament will be discussed later in this article. First eliminate the possibility of vibration caused by the X lamp in use in the system by installing another. If the microphonic noise is still heard install a third. If the noise still remains place a card or some other opaque object between the X lamp and the optical system. If the noise disappears the trouble lies in a faulty optical system. However, should the noise persist, one of the "head amplifier" tubes is of a microphonic characteristic.

Should any of the above conditions occur it is most advisable to inform the sound engineer covering the theatre of the existence of this trouble.

Exciting Lamp

In a recent issue of a magazine there was a lengthy and detailed discourse on exciting lamps, their construction, useage, etc. In this article I want only to treat with remedies for troubles caused by exciting lamps.

First of all, before installing an X lamp in its holder observe the filament and make sure that it is horizontal. Should a ringing or microphonic noise develop in the system place a card between the X lamp and the optical system, if the ringing disappears it is caused by the X lamp or, as previously described, by the optical system. Assuming that it is the X lamp in this instance, line up the X lamp by sight. With the fader open and the system on, make a careful adjustment by sound; i.e.: move the X lamp up and down until the ringing noise either dies out or is reduced to a minimum. At frequent intervals tighten the X lamp holder and bracket, as any looseness will cause foreign noises to enter.

There has been some controversy regarding a 3.4 amp. setting versus a 3.8 amp. setting (for a 4-Ampere lamp). All lamp filaments, regardless of the type of lamp, expand when current flows through them. The more current the more expansion. At 3.8 the filament sags considerably more than at 3.4. The more the filament sags the more chance there is for it to vibrate while the machine is running. In short, the very minute movement of the filament in relation to the "slit" in the optical system causes the ringing sound. If the vibration of the filament can be minimized the ringing or "machine" noise will also be minimized. Besides the added life received by using a low current, the exhibitor, who foots the bills, will be well satisfied.

Hollywood In Chicago

A Model Hollywood, comprising a generous slice of California's movie colony brought to Chicago and set down on the shores of Lake Michigan will be one of the features of A Century of Progress Exposition. Here the public will see "talkies" made before their eyes, welcome their favorite stars in person and catch closeups of the life in Hollywood.

No Let-Up on Third Dimension Pictures

A RECENT EXPERIMENT

THE projection of motion pictures in relief, visible to a group of observers occupying a wide range of positions with respect to the screen, but demanding no special spectacles or other apparatus at the eyes, has been experimentally realized on a small and crude scale, according to disclosures made before the National Academy of Sciences, recently, by Dr. Herbert E. Ives of Bell Telephone Laboratories, New York. This extension of Dr. Ives' three-dimensional work from still pictures to motion does not employ the conventional celluloid film, but harks back to a toy which the older generation will remember in which a series of pictures are mounted on a revolving wheel. Although the action lasts only a couple of seconds before it repeats, the spectator sees a true motion picture which has all the depth and roundness of a stereoscope view. The cumbersome wheel is thus far essential, according to Dr. Ives, because of the high degree of accuracy of position needed to project the pictures on a special screen, and serves to emphasize his caution that commercial application seems remote.

Showing Stereoscopic Relief

To understand Dr. Ives' latest development, one must first recall that seeing anything stereoscopically means that one sees it with each eye from a different viewpoint. The brain then interprets the slight differences in the two retinal images as meaning that the scene has depth. In the familiar parlor stereoscope, each eye sees a different photograph, the pair having been taken initially through cameras about three inches apart. If motion pictures are taken in a similar manner, and viewed in such a way that each eye sees only the picture meant for it, there will be an illusion of depth in the picture. So far, the successful methods of doing this have involved the projection of the pictures alternately or in two complimentary colors for the two eyes, and either a rotating shutter in front of each person or a pair of spectacles, colored red and green, to prevent the eyes seeing any but the appropriate picture. Dr. Ives' developments break away using anything on or near the beholder; the optical apparatus ends at the screen.

This screen is one of the basic elements of the system. It is made up of vertical celluloid rods, about a quarter-inch wide, and ground to accurate cylindrical curvature at front and rear. The curvature of the front face of each rod is such that rays of light starting from an elemental segment of the rear face are refracted in a narrow parallel beam toward the observer. By impressing successive elements of the picture, in the form of vertical lines on the back of successive rods, the whole picture is built up for the observer. The picture on each successive element of a rod is refracted in a slightly different direction, so that the two eyes of each observer will see different pictures as built up by two different series of picture elements. Since these two pictures are appropriate for left and right eyes respectively, a stereoscopic image is seen.

To place the picture elements on the rear surfaces of the rods, the latter are given a frosted finish, and a lantern slide is projected on them. Making this slide is, however, a difficult proposition. Since the ultimate spectators, if there be any considerable number of them, will probably be spread over an angle of thirty degrees on each side of the auditorium, or a total angle of sixty degrees, the original picture has to be made from a series of viewpoints extending over an arc of sixty degrees around the object. One way to do this would be to take a series of pictures, either successively by a single camera, or simultaneously by a group of cameras arranged along the arc of a circle and pointing toward the object at that circle's center. These schemes are, however, cumbersome and expensive. It is desirable to make the pictures with apparatus employing a single photographic exposure. In order to accomplish this, Dr. Ives had recourse to a concave mirror four feet in diameter. Light rays from the object placed at the focus of the mirror would be reflected back to a focus at their origin, were it not for a semi-trasparent plane mirror which reflects them off at right angles. At the new focus of the mirror which has been thus established, a group of images of the object are formed, one for every possible viewpoint around the concave mirror. These images are superposed, but it is possible to disentangle them, since the rays which form each one differ in the direction from which they approach the focal plane. The discrimination between images is effected by interposing a glass screen of fine concave grooves. This breaks up each image into a series of lines spaced regularly across a photographic plate. In the space between adjacent strips of one view appears, in order, a strip from each other view, so that if one eye of the observer could see but one family of strips, it would perceive the picture as viewed from one point on the concave mirror as though seen through a grille of thin vertical wires. Precisely this effect is achieved by making a lantern slide from the plate and projecting it upon the back of the glass screen described in an earlier paragraph. It will now be understood why each eye of the ultimate beholder sees a different picture, the difference being that of beholding the original scene from two viewpoints a few inches apart. Stereoscope vision is thus attained, and those who have seen Dr. Ives' laboratory set-up have reported that the effect of depth is well marked.

To make a motion picture, it is necessary to project successively varying pictures on the screen. It will be appreciated that the minute accuracy necessary to register a fine structure of lines exactly upon a series of rods can only be secured by glass plates firmly but adjustably mounted on a rigid moving support. Dr. Ives therefore affixed his series of 32 transparencies to a rotating disc so that each plate could be separately orientated in the optical system. Since the pictures do not halt in the projection gate, it was necessary to flash a light through each as it reached the projection point. All in all, the size and delicacy of the apparatus emphasize Dr. Ives' caution that commercial application seems remote, while the lifelike quality of the moving image is convincing evidence that another milestone has been passed in the development of motion pictures in relief.

Showmanship in the Projection Room

BY JAMES H. DAVIE

IN the past it has been the job of the manager to bring people into his theatre, to keep them there, and to bring them back. This was done by the manner in which he presented his program. The operator's job was to keep the light coming through the projection ports with a picture, and, as long as there were no breaks, and the light was good, his job was done. That was all that was required of him.

With the advent of talking pictures, this is all changed, and the operator assumes a far deeper responsibility. It is up to the projectionist, to-day, to present the program in such a way that the audiences are satisfied and will enjoy the performance well enough to come again. The projectionist is, in a great sense, responsible for the sound results in his theatre. It is in his hands to either make or break a performance. A good picture may be utterly ruined by poor control of sound. The interest of the audience in the show lies in its ability to hear the spoken parts with the greatest sound comfort, and the music with the full richness of tone that it deserves.

Fader Very Important

The Fader is an important piece of equipment in the projection booth. In it, lies the success of a show. With it, a bad picture may be greatly improved and made more interesting by establishing a volume level which will hold the interest of the audience. Cue sheets, or any other fixed guide cannot be used with any assurance to fix a volume level for any two performances.

The reasons for this are as follows: First, the size of the audience. The larger the size of the audience, the greater is the absorption of sound. This requires an increase in volume. (There may be a difference of 4 to 5 points between a half full, and an entirely full house). Second, the temperature and humidity in the theatre cause a difference in the volume level. A cool, dry temperature does not take the same volume as warm, damp air. A cool, dry air is a better sound medium.

In the early days of talking pictures it was necessary to provide the projectionist with an elaborate cue sheet to inform him when to bring up his volume and indicating the weak parts of the picture. This practice has now been stopped, and the judgment of the operator is depended upon to make his own adjustments. The old time cue sheets were provided in order to make up for differences in sound levels caused by the recording equipmènt or by the process of developing and printing. The newer and more modern systems and methods have done a great deal to overcome these differences in sound level altogether. They are still there, however, and it is up to the projectionist to find them out for himself, and to correct them. It is only by conscientious effort on the part of the operator, and his interest in his job, that it is possible for these flaws in the program to be corrected, and thereby continue to hold the attention and interest of the audience.

It always has been, and still is, considered very bad projection to show a white sheet, or a black out, for any length of time. It is important to keep a picture on the screen and it is equally important to keep sound coming through from the stage speakers during the entire performance. There is always a lapse of sound between subjects and partiuclarly at the censor titles, and at these points, a little non-sync music would carry the audience over, orally, from one part of the program to another. This prevents the audience from falling into conversation, which distracts from the entertainment. Just as it is necessary to hold the audience's attention visually, it is equally important to hold it orally.

It is not always necessary to use the non-sync music between subjects if the ends of the subjects are long enough with music to lend themselves to what might be called a good sound changeover. When the end of a subject comes by, showing only a few frames of the finish title, and while changing the picture over onto the second projection, the music on the old projector may be used to play while the censor title is running through the second one, until the sound commences on the second projector. Then the fader may be brought over. First the light, and then the sound.

Non-Sync Helps Show

Some theatres are equipped with a non-syncronous turnable, and do practice playing between subjects. This produces a fast show, and aids in holding it together. In addition, such a piece of equipment can be used to open the house. A few records played at the opening of the show, provides entertainment for those already seated while the house is filling up. A good march number for the end of the performance has the effect of sending the audience away with a complete feeling of enjoyment. This is what is known as good showmanship and salesmanship.

One manufacturer of talking picture equipment has, for some time, provided a variable line equalizer with his system. This is a feature which gives the projectionist unlimited control over the tone of his sound. Recently another manufacturer has taken up the idea and has incorporated a similar device into his latest systems. By means of these equalizers and tone controls it is possible to work a show to its fullest. It is desirable to have these tone controls variable in order to compensate for the differences in recording.

The frequency characteristics of recording amplifiers vary to such a degree that the sound is never the same for any two subjects. Some are very bassy and others quite thin. The tone control enables the projectionist to compensate for these differences and to establish a tone suitable to the acoustics of his theatre, allowing the maximum bass, without making his sound blurred. When too much bass is taken out, the sound becomes thin, and there is the effect of the artist being taken off, back stage. A fullness of base in the speaking parts brings about a more intimate feeling between the audience and the screen. On the other hand, excess bass, in houses where the acoustics are bad, sets up bad echoes. Some tone controls are fixed to either cut the bass, or allow it to pass. This enables the projectionist to work his musical parts allowing the full bass in on music and cutting it out in speech parts. With a tone control the projectionist is allowed an unlimited scope to display his ability as a showman.

For Best Results

The following is a typical example of how a show might be controlled in order to obtain the very best possible results: It opens with a newsreel, with introductory music. Here the full bass is needed, with the volume slightly louder than usual running level, in order to bring the attention of the audience to the program and to stop conversation, which is always present at the beginning of a show. If the first news item contains speech, the adjustment should be made in order to obtain the best sound for that part. Between news items there is usually a short piece of music accompanying the titles. Here again, the bass should be allowed. The same is true of other short subjects in the early part of the program. Then the feature picture should be opened with a "punch" bass, and a little volume. If it is a musical number with singing the bass may be cut somewhat in order to obtain the proper reproduction and naturalness of tone. A touch of volume at the ending of musical numbers is helpful. The proper control of a program takes good judgment and training.

Film Tints To Suit Film Subjects

AN EASTMAN DEVELOPMENT

IT is certain that many of the emotional moods which the motion picture seeks to capture reside in colors rather than in gray tones. Psychologically the grays have a subduing, sobering power, and this power is constantly at work upon the observer of a motion picture which is screened in the monochrome of ordinary untinted film.

Although gray may deepen certain moods of the screen, the peaks of emotion are usually flattened off by it, an effect which is far from ideal. A wider range of stimulation and depression seems possible through a systematic use of the affective values of different colors. The language of color as applied to the screen is still rudimentary, but that colors do have certain consistent emotional effects is well established by psychological tests.

Sonochrome films consist of Argent, a silvery hueless substitute for clear positive, and a series of sixteen chromatic tints spaced approximately equally along the gamut of visible colors and separated one from another by about eight just perceptible hue steps. In expressive hue values the Sonochrome series thus provides a complete variety. The saturation of all the tints is low enough so that they can not become distracting elements in the scene but remain entirely atmospheric effects.

One of the principal merits of the Sonochrome tints is that in hue and saturation they can closely simulate the actual lighting of any exterior or interior scene. Lighting of realistic color content is a primary emotional source to which the motion picture has never before had such free access. The motion picture must use a universal language, and many of the universal affective values of colors have their origin in the chromatic quality of the light which ordinarily illuminates real scenes. The many variants of sunlight, moonlight, lamplight, and firelight are reproducible with Sonochrome tints with surprising fidelity.

When a single pervasive color is used on the screen the observer tends to relate it either directly to some light source or to the reflection from some large area of a single dominant color which occupies a considerable part of the picture. These two effects comprise the chief realistic uses of the Sonochrome tints and are the easiest to employ. But these uses by no means exhaust the possibilities of the tints.

Thus Verdante, a delicate green in the series, connotes by direct objective association young foliage, grass, gardens, and the vegetation of Spring, and hence is particularly useful in the rendition of scenes containing these elements. It may, however, be used effectively on scenes objectively very different, for the suggestion of youth, freshness, hope, aspiration, and those moods closely linked in our consciousness with the springtime of life. Our response to this color has become so definitely fixed by association with it in Nature that wherever it is used it tends to produce the same physiological effect, which is a step away from the feeling of complete ease and tranquillity toward the stimulative side. The true effect of the tint may easily be experienced by looking through the Verdante film on the color wheel at a drawn white window shade or by viewing the color projected on a screen with an arc projector. Further experiments with the Verdante film superimposed on various scenes printed on untinted positive will show that it tends to bring out the refreshing, mildly invigorating character of scenes of the types just described, that it partly nullifies the impression of a somber scene, and that it pulls down the mood of a scene that is impassioned and full of excitement. In similar tests on the complete series of Sonochrome tints the reactions of many observers show close agreement as to the basic mood of each tint. For reference, these reactions to the separate tints have been briefly summarized in the present booklet.

For Sound Pictures

Previous attempts to use color on sound film have resulted in cutting off the light that excites the photoelectric cell, so interfering with the reproduction of sound. With the new Sonochrome tints this difficulty has been overcome, for they are so adjusted as to position in the spectrum that they do not blind the photoelectric eye. The light to which any of the present commercial photoelectric cells respond passes freely through Sonochrome film, and the response is uniform over the entire gamut of tints.

For this reason Sonochrome tints may be used in any sequence, permitting absolute freedom in the shifting of moods, without affecting the sound.

It is strongly recommended that the hueless tone, Argent, be used for all untinted scenes, since smoother transitions in both color and sound tone are possible with it than with ordinary positive.

Brief characterizations of the various Sonochrome tints are offered in the paragraphs following.

Rose Doree.—A rose pink that quickens the respiration. The tint of passionate love, excitement, abandon, fete-days, carnivals, heavily sensuous surroundings.

Peachblow.—Allegretto vivace. A tint for brief, joyous moments, buoying up scenes of light, sensuous content. The spirit of coquetry. An excellent tint for close-ups.

Afterglow.—Less radiant than PEACHBLOW, yet warm and stimulating. Cafe, banquet scenes, gardens, sunsets, late autumn.

Firelight.—A cheerful orange tint —in interiors suggestive of warmth, intimacy, comfort. A mellow autumnal light.

Candleflame.—In the middle tempos, but blending happily with all active moods. For general use in interiors. For exteriors morning and afternoon, with but little sky area.

Sunshine—The generous brilliancy of mid-day sunlight. Of use where the light of the sun plays prominently in fixing the locale or the mood... sunlight streaming through windows, Mexican patios, the desert.

Verdante.—In the larghetto range. Refreshing. The sunny green of vegetation in spring and early summer. Simply furnished interiors.

Aquagreen. — Emotionally cool, soothing, relaxing. Especially suited to water scenes outside the tropics. One of the wettest colors imaginable.

Turquoise.—With the liquid characteristics of AQUAGREEN, but cooler ...the Mediterranean, the cool of dawn, bright moonlight.

Azure.—The tint of reserve and distance. In exteriors spacious, atmospheric—the blue of tropical skies. In interiors cold, formal, repressive.

Nocturne. — For night effects, murky interiors. Maximum repression. The color mood of sadness, defeated expectation, dark intrigue, the underworld.

Purplehaze.—Rising somewhat in pitch from NOCTURNE. For dim interiors and outdoor settings obscured with haze. Languorous, dreamy, narcotic.

Fleur de Lis.—Tempo di marcia pomposo. The time-honored hue of the ceremonial, the ritualistic. Pompous, solemn, stately. The purple of royalty.

Amaranth.—A less austere purple than FLEUR DE LIS. Suggestive of gentility, aristocracy. Heightening the elegance and luxury of certain interiors. Balcony scenes at night illuminated from within.

Caprice.—In the range of rapid tempos. An audacious magenta. The mood of fickleness, impulsive action, rash adventure.

Inferno.—Agitato. Intensely stirring with strong sounds and movements...fiery revolt, riot, conflagration, disaster, unrestrained passion.

Argent.—A silvery hueless tone, less harsh than that of ordinary black and white positive. Of general utility for all untinted scenes.

Automatic Volume Control

By J. KENNETH HILER

EVERY now and then the subject of automatic volume control bobs up to bother projectionists. If radio sets have automatic volume control why can't it be adapted to sound reproduction in the theatre? Why hasn't some one perfected the idea? What is required of the automatic volume control? How does volume control in radio receiving sets work? Mr. Hiler attempts a simple answer.

FOR the theatre auditorium we want a mechanical or electrical device which is capable of doing what we now try to do with the fader. Keeping an even sound level in the theatre at all times without spoiling good illusion is part of the job. If this device were so designed that it would maintain an even output level from our sound projectors, the fader could be set and then forgotten. We could even have the change-over from one machine to the other automatic and eliminate the fader altogether and set our gain control on the amplifiers to the proper pre-set position. Or, if this device had a variable volume control on it we could set that to the proper level and all we would have to worry about would be to check for the quality of sound coming from the screen; the volume would take care of itself.

The automatic volume control device would even out the differences in photo-electric cell and machine amplifier outputs, differences in film printing and developing. It could also be arranged to bring up the volume as the auditorium became filled up with people.

In other words the volume would be constant for all situations no matter what the condition of the equipment was. For example if the photo-electric cell has become weak, the device would automatically bring up the amplification to a point equal to the defficiency of the cell. Such devices are not new and could easily be incorporated in the installation of the sound equipment. But why haven't they been used?

Started With Radio

Automatic volume control was first discussed in connection with radio broadcasting. They tried to replace the trained operator in the broadcasting station with an automatic device but they soon found that it was impractical. It was especially bad for music because it tended to kill or remove expression between loud and soft passages in orchestrations or singing. To some people this might not be noticeable or even objectionable but to most of us it would be serious.

For dialogue such as that used in travelogue pictures where there isn't much contrast in loudness of voice, the automatic volume control would be ideal. It would take care of all the variable elements which tend to give us uneven output levels, and which we strive continually to avoid by adjusting the fader control. But, in scenes calling for whispering voices one minute and loud voices the next, it would be ridiculous to have all the sound levels emitting from the screen at the same loudness. The maintainance of proper sound illusion is essential and it can be readily understood that even volume under these circumstances would ruin good illusion.

Not Yet Refined

So far no mechanical or electrical devices have been able to differentiate between situations where loudness of sound is used to express ideas or moods. If the mechanism were set for a certain volume it would increase or decrease all sounds to that level. This would do more harm than good, because it brings in a distortion factor that soon would be very displeasing to most people.

An automatic volume control of special design can be used to achieve even output levels without spoiling illusion but the use of it would require radical changes in the present methods of recording and reproduction. The cost of the changes necessary to do this with the present equipment makes it almost prohibitive.

To be sure radio receiving sets have automatic volume control systems of one kind or another. The radio method does not alter the audio frequency component of the signal received so it really is not an automatic volume control in a certain sense. If you were listening to a radio program and some one in the broadcasting studio shouted or made a loud blast on a wind instrument, the noise would be much louder coming from your loudspeaker, that is, if the operator in the broadcasting station was not able to reduce the output from that microphone in time. And if one of the tubes becomes weak in the audio stages of the radio receiver the volume drops off so we really haven't got an automatic volume control there either. The system which radio uses controls only the radio frequency carrier wave which brings the program to you and quite faithfully maintains an even carrier wave. In doing this it doesn't remove the illusion, only reduces fading somewhat and in tuning from one station to another keeps them all at about the same volume. Some may seem to be louder due to their employing a higher percentage of modulation of the radio frequency carrier at the broadcasting transmitter but as all the stations are now nearing one hundred percent modulation, the weaker carrier is automatically brought to the same strength as that of the stronger one and the modulation percentage is the same, the sound volume output would be the same.

In sound on film we have no such carrier frequency which we can control that would not effect the audio output. So for the present automatic volume control is not practical. The only alternative is a gain control operated by some properly trained person located in an advantageous point in the auditorium. Sometimes even this is not practical.

A Lighting Marvel

If you want to inspect the operations of "the things that can't be done," visit the modern motion picture studio. Alleged impossibilities hold no terror for the motion picture engineer. One recent example of this is a stunt to make a 300 watt Mazda incandescent lamp do the work of a 1500 watt lamp!

A 300 watt, 120 volt Mazda lamp is actually forced to burn at about 190 volts. Under this extraordinary electric pressure the length of life is, of course, shortened very much. But, the output of photographic light is excellent. It is blue-white in color, and is practically equal to the quantity of light obtainable from a lamp of five times the size. It works when you want lots of light but for only a short time.

One particular reason for handling motion picture lighting in this fashion is to permit the use of small portable electric generators or storage batteries when taking pictures on location outside the studios.

The idea was worked out by Mr. M. W. Palmer, President of the Motion Picture Lighting Company in collaboration with lighting engineers of the Westinghouse Lamp Company. Mr. Palmer believes that with a relatively small and portable automobile truck, equipped with storage batteries, he can handle almost any "set" and achieve satisfactory night photography regardless of how remote from civilization or how remote from a source of electricity the scene may be.

The Value of Equipment Servicing

ANONYMOUS

> The article on this page goes counter to much current (and weighty opinion) and counter also to much prejudice toward (1) the service engineer as a human being and (2) the value of the servicing of sound equipment as supplied by the leading sound equipment manufacturers. As a human being, the service engineer is no better and no worse than human beings generally are and there is no doubt that he tries to do his job intelligently and diligently. The writer offers a brief defense of servicing only and is expressing his own views.—EDITOR.

THE great worry of the motion picture exhibitor is his customers. Are they, he asks himself day and night, getting what they want and will they come back? His box office receipts give him the answer on every picture.

I will admit that there are many elements about a theatre that keep patrons satisfied or dissatisfied. I am not qualified to speak of them all. But one of the most important of these is the quality of the sound reproduction.

Theatre-goers will often forget hard uncomfortable seats. They will not mind walls that may need a repainting job. The worn carpet under their feet will pass unnoticed. But will they pass off a dark screen; will they sit complacently before a picture suddenly struck dumb; will they take kindly to harsh, jarring noises, blasts from the horns and many other phases of imperfect sound reproduction?

Perfect sound reproduction is one of the major factors in providing satisfactory entertainment.

It is for this reason that the more responsible sound manufacturers and theatre owners have cooperated in a system of servicing which takes in the whole country.

The economies resulting to the exhibitor from this unified service are numerable. The most outstanding of these will be discussed briefly.

Frequent Inspection

Routine inspection which is one of the most important "services" performed by the servicing oragnizations frequently nips an incipient trouble that might result in a serious interruption of the show. There have been cases where a screen has gone dark in the middle of a show. While a hurry call went out for the service engineer the audience either sat in great impatience and resentment or money had to be refunded. One such situation might be forgiven. Two would be inexcusable and would cause serious damage to the prestige of the theatre. Maintaining a regular schedule without any interruption "except for an act of God" is one of the cardinal reasons for being of all service engineers. He is a doctor who is paid in the Chinese manner: paid for keeping his patient always well.

When the service engineer visits a theatre, part of his duties is to give the projection staff all information which will help to make a better show. The more the projectionists know, the more self-assured and more confident they are in the duties of their work. As a result, the theatre enjoys a "good sound" reputation and the patronage of a large public.

Organized Service

If a service of this sort were not available, each theatre would have to set up a service organization of its own. It would be very costly.

A unified service effects overhead economies and has many advantages over a haphazard service policy. Men in the Service Department are thoroughly familiar with the work required of them. They are generally college graduate engineers, or men having long experience in communication engineering. They are specifically trained for service work. In this way, the theatre is assured of the highest type of service possible. In the event of damage to the equipment, as in the case of fire, the service engineer immediately functions, so that the show will not be delayed because of the sound equipment. The exhibitor in such emergencies need not pay an exorbitant fee to an "expert," because he knows no other solution of his difficulties.

Considering all factors involved dependable service effects a great economy in the operation of a theatre. It certainly gives the exhibitor a feeling of security.

Sound Replacements Rapid

By G. K. RUDOLPH*

WITH announcements from the leading studios indicating that the forthcoming season's product will be of a higher quality than at any time since sound became the screen's dominating factor, nothing is of greater importance to the exhibitor than the equipment that presents the product of the studios to his patrons. Discriminating men, women and children,—and the great majority of motion picture patrons may be placed in that classification, now demand sound of the highest quality. If they are unable to enjoy complete sound satisfaction when they visit the theatre, they soon go elsewhere for their entertainment.

Generally speaking, sound of acceptable quality is recorded in the majority of the leading studios. Some is better than others and in a few cases, the recording is superior. Certainly the principal producing corporations have spent vast sums of money and are constantly spending more in their efforts to turn out pictures that will attract money to the box offices of the several thousand theatres throughout the world. However, no matter how much they spend for recording, if the reproducing equipment in the theatre is inferior, the picture will be presented to the theatre patron in an inferior manner. Therefore, the leading manufacturers of sound reproducing equipment continue to emphasize the importance of their arguments in behalf of theatre apparatus that will deliver satisfactory sound to the patron.

With the number of installations in July of this year exceeding those made in July, 1931, and with indications pointing to a new record for August, RCA Photophone, Inc. approaches the coming fall and winter season with keen anticipation, according to an announcement from the company's headquarters at the RCA Victor plant in Camden, N. J. Ever since Photophone's early summer announcement that its entire line of sound reproducing apparatus had been adapted to AC operation, along with a reduction in the prices of the several models and a marked reduction in contract service charges, business has shown a constant increase.

While the number of installations made in new theatres has not been so large as in former years, replacements of other apparatus have increased each month during the past year. Photophone executives have argued at all times that in the end the wise exhibitor would come to a realization of the fact that he would have to install high quality sound apparatus if he hoped to satisfy his patrons and they now say that the emphasis they laid upon their argument has borne fruit. More Photophone equipment has replaced other apparatus in the past six months than in any year of the corporation's existence and in spite of the so-called depression that has caused many theatres to close, Photophone expects to close the current year with new records.

---

* Photophone Division, RCA Victor Company.

"If the exhibitor hopes to satisfy those who will visit his theatre to see and hear the improved product of the leading studios, he will have to give them high quality sound," said an executive of RCA Photophone to a representative of MOTION PICTURE PROJECTIONIST. "Poor sound has driven more patrons away from the theatre than poor pictures. And when sour sound is inflicted upon an audience that has assembled to see and hear a good picture, the exhibitor can offer no legitimate excuse. The best recorded picture is doomed to failure if the reproducing apparatus is of an inferior type and such a condition is not fair to the producer of the good picture. The large studios are bending every effort to turn out superior pictures and when they invest their millions in recording apparatus, high salaried players, story material and expensive sets, they are entitled to have their product presented in a manner that will please the patron."

Inferior sound reproducing equipment, unable to capture the extreme high and low frequencies that are impinged upon the film in the processes of recording, is rapidly disappearing from those theatres that come under the classification of better theatres, and progressive exhibitors are more conscious of that fact than ever before. In the final analysis, the theatre patron will determine the life of the motion picture theatre as a whole. Millions of loyal fans have been driven away from their favorite places of amusement because even their receptive dispositions were unable to accept the poor quality of sound that distorted the dialogue of their favorite stars. Those millions can be reclaimed if exhibitors will see to it that their theatres have reproducing equipment that can faithfully and satisfactorily bring the words of the artists, the true reproduction of all musical instruments and such other sound as may be required, to and through the screens and delicately constructed loud speakers.

A New Exposure Meter

Light intensity measurement has been placed on the same basis as the measurement of amperes or volts by the Weston Electrical Instrument Corporation, using their newly developed Photronic Photoelectric Cell. The latest use to which they have placed this remarkable electric eye, is a Universal Exposure Meter for photographic use, in which brightness measurements are taken directly from the scale of an instrument easily read by the layman.

This Exposure Meter is scientifically designed to give accurate exposure information for both "stills" and "movies." It consists essentially of two parts, (1) an electrical instrument operating from two Photronic Photoelectric Cells located in the back of the meter and (2) a simple, novel mechanical calculator for translating the brightness measurements into proper apertures and shutter timings for any plate or film speed.

It is always ready for use as no batteries are required and no adjustments necessary. It is independent of climate conditions and intensity of light.

"WE WANT HIGHER SCREEN BRILLIANCE!"

THE PROJECTIONIST'S DEMAND
THAT *MADE*
THE SUPER CINEPHOR SYSTEM

"Improve our projection lenses" you said, "that's the best way to give us higher screen brilliance and better projection."

Like all good craftsmen we like a challenge. So we went to work for several years and built the Super Cinephor. The formula is the secret of the world's leading optical scientists. The glass is all made in the B & L plant and the *performance* of the new Super Cinephor is a revelation.

Ask the man who has used one! Ask your National Theatre Supply Man too . . . he's got complete information.

Your request will bring an interesting booklet on Super Cinephor, the big new aid to superior projection. Better write us today.

Patented Condensing System

THE new Patented B & L Condensing System used with the Super Cinephor increases screen brilliance 50% to 100%. . . . . . . Ask your National Theatre Supply man about this big projection aid.

BAUSCH & LOMB OPTICAL COMPANY

680 ST. PAUL STREET ROCHESTER, NEW YORK

More About Troubles

By CHESTER R. UNDERHILL

EDITOR'S NOTE: The article on this page came to us in the form of a communication from Mr. Chester R. Underhill, well known in the sound engineering field.

Mr. Underhill wrote: "I have just read with considerable interest the well written articles in the August issue by Mr. Lloyd Harding and Mr. Kenneth Hiler on sound head troubles and noiseless recording and ask the privilege of commenting briefly upon them both."

This privilege is extended gladly. Mr. Underhill's letter is itself a very complete and very interesting treatise on the subject.

Mr. Harding, the author of one of the articles passing in review before Mr. Underhill's critical judgment will reply in the next (October) issue.

MR. HILER'S article is in answer to a more or less vague question by Mr. Frederick Brant concerning the reasons for noisy noiseless recording reproduction. In his treatise on the subject Mr. Hiler has overlooked a number of the most common causes for this phenomena (extraneous screen noises) but has stressed specific causes common to only one well known make of sound equipment. Reference is of course made to noise caused by PEC amplifier microphonic tube trouble and vibrating exciter lamp filament trouble.

To be sure, every type of sound equipment has its own particular characteristics and for this very reason Mr. Hiler would have been on firmer ground had he asked Mr. Brant to disclose the type of equipment he was having trouble with before being so specific in his solution of the problem involved. A scratched or dirty soundtrack, for instance, and improperly adjusted guide rollers probably account for the largest percentage of so called background or ground noise encountered in actual reproduction.

Mr. Harding's article starts off with a commonly made and excusable error, that of confusing alternations with cycles. 96 interruptions or alternations a second will cause a 48 cycle note for the simple reason that it takes two alternations or "interruptions" to make one complete cycle.

This applies to either a mechanical or electrical wave motion.

His remarks anent the cause of this type of interference and proper remedies are excellent and quite accurate.

In the case of soundheads, however, where provision is made for moving the optical barrel laterally to center the light beam in the soundtrack and that employ a guide roller to hold the film in proper place, an important adjustment has been overlooked which, if understood, will relieve the projectionist to a large extent from further worry caused by frame line or sprocket hole noise.

In this type of head (such as RCA type B, C, D and F) a split guide roller, similar to that used in the Simplex gate, is mounted directly above the soundgate to prevent film weaving as it passes by the light beam aperture of the gate. A spring is used behind the back flange of this roller which prevents the film from weaving "back" and tends to push it forward. A small collar with a set screw is mounted on the guide roller shaft proper immediately in front of the front flange. It is this collar that is designed to prevent the film from weaving "forward." Its correct adjustment is simple and well worth remembering.

1. Close soundgate.
2. Loosen set screw of collar.
3. Push collar and flange towards soundgate until there is only enough clearance between gate and guide roller flange to allow latter to rotate freely.
4. Tighten set screw in collar.

And the guide roller adjustment is complete. The film cannot weave in either direction. The light beam may now be properly lined up by either the "buzz track" (audible) or dental mirror (visual) methods by following Mr. Harding's instructions.

In considering soundgate troubles the projectionist should ever bear in mind that the shafts of the lower take-up sprocket of the picture head and constant speed sprocket must be absolutely parallel and the sprockets themselves in perfect alignment for if they are not a baffling attenuation of high frequency notes will result. This condition may be checked by observing the moving film with soundgate open. It should run straight and free, no "bellying out" or "tightness" of either edge should be tolerated. An improper alignment between picture and soundgate will cause this trouble and the resulting distortion blamed on everything from optical system through to the stage speaker.

A Picture in the Dark

In the March issue of *The Electric Journal* there was reproduced a photograph showing a group of perhaps fifty or sixty men, which was made when the room in which they were assembled was in inky darkness. When this picture was made, these men could not have seen their hands before them. Actually, however, the room was flooded with invisible infrared radiation.

In one corner of the Eastman Kodak Research Laboratory, in which the picture was taken, was located a booth containing fifteen 1000-watt electric lamps pointed toward the ceiling. Over the booth were filters which screened all visible light and permitted only the infra-red to pass into the room. The negative was made with an exposure of one second and a lens setting of *f.* 3.5. The film used was a special infra-red sensitive plate hypersensitized with ammonia. This film is a product of the Eastman Research Laboratory and is, at present, not commercially available.

One of the reasons for using infrared light in photography is that it can penetrate far better through hazy atmosphere than can visible light. For photography at great distances it is exceedingly valuable, for astronomical work, for instance.

The greatest distance photograph yet made was by Captain A. W. Stevens of the U. S. Army Air Service in South America. He photographed the peak of Aconcagua 310 miles distant, from an airplane. This remarkable picture showed the line of haze over the Pampas as curved, owing to the curvature of the earth.

For photography of this type the only limit to the range of the camera is said to be that fixed by the curvature of the earth. These pictures are made in brilliant sunlight, a filter being placed over the camera lens to shut out the visible light.

S.M.P.E. Votes On Officers

Ballots have been sent out to all members of the Society of Motion Picture Engineers for their votes on all officers of the Society for the coming year. The name of Dr. A. N. Goldsmith is the only one listed for the office of President. W. C. Kunzmann and A. C. Hardy are the nominees for the post of Vice-President; J. H. Kurlander for Secretary; H. T. Cowling and M. W. Palmer for Treasurer. Nominees for Governors are W. C. Hubbard, R. E. Farnham, M. C. Batsel and H. Griffin.

Aperture Makes Projection History

EDITOR'S NOTE: *The exchange of correspondence between Mr. Harry Rubin, chief of Projection for Publix-Paramount and Mr. Virgil Miller, acting for Mr. Irving G. Thalberg, Production chief for Metro-Goldwyn, brought to a partial close the controversy over a new-sized projection aperture. It is a significant stage in the unceasing effort to bring the studio technique in line with theatre requirements. Mr. Rubin's short note to Mr. Thalberg is a masterly exposition of the theatre's point of view and reveals an understanding that is beyond dispute. That the studios did not wholly agree in no way invalidates Mr. Rubin's position. The whole controversy displays a fine cooperative spirit and will surely lead to a closer kinship between production and projection groups. The* MOTION PICTURE PROJECTIONIST *publishes this correspondence as a bit of important history on the development of projection technique.*

Notification as sent to the studios announcing the final adoption of the Recommended Uniform Aperture.

This will serve as official notification that a camera aperture .631" x .868" is hereby recommended by the Academy of Motion Picture Arts and Sciences as uniform practice to go into effect immediately.

A meeting this afternoon resulted in the settlement of the controversial points which have been under discussion since the final report of the subcommittee was submitted January 5. Representatives of Fox, Metro-Goldwyn-Mayer, Paramount, RKO-Radio, United Artists and Universal studios were present and agreed unanimously that the above recommendation should be made immediate practice.

Further details and information will be furnished your studio by the Academy office.

Very truly yours,

IRVING G. THALBERG, Chairman,
Producers-Technicians Committee.

From Mr. Rubin

DEAR Mr. Thalberg:

In reply to telegraphic request from Mr. Lester Cowan, dated December 20th, requesting that I write you outlining my reasons for favoring .590" height of projection aperture and also how 18-degree angle was determined, would say that 18 degrees represents the lower limit of the average angle existing in our Class "A" and "B" houses, and, as these are the important box-office producers, the picture should be presented in them in its best form and in order to adhere as closely as possible to the desired 3 x 4 proportion, the projection aperture would be .590" high by .825" wide, which, when projected to the screen would produce a 3 x 4 picture.

In our larger seating capacity houses of the Class "A" group, the angle in many instances is 21 and 24 degrees and in these houses it would be necessary to further reduce the aperture to .585" and, in the maximum instance, .580", but as this reduction would cut off part of the picture we are more inclined to depart somewhat from the 3 x 4 proportion and retain the full photographed area.

Reducing the projection angle to 15 degrees and increasing the aperture to .600" is penalizing the Class "A" houses by further department from the 3 x 4 proportion or resorting to tops and bottom cut-offs, without any particular advantage to the houses of the less than 15-degree angle.

In no instance can we secure a 3 x 4 picture from a single standard camera aperture that will conform to all of the angles from zero to 24 degrees and it being therefore necessary to secure and agree upon a compromise point, I believe that the .590 x .825, which is correct at 18 degrees, is the most satisfactory answer.

From Mr. Thalberg

Dear Mr. Rubin:

Mr. Thalberg has asked me to reply to your letter of December 21.

The information you gave on Publix houses is very valuable and was considered at a meeting of the sub-committee with the representatives of the major studios.

At the start of the project the studios hoped to secure a few mils higher projector aperture than the .600" for which they have had to compose for the past two years. This was one of three main objects, the others being to reduce the excessive distance between the proportional aperture and the frame lines and to stop the expensive nuisance of having to compose pictures for full disc frame, movietone frame and proportional aperture. On the grounds of composition and photographic technique the studios have strong arguments that the extra height area would benefit the picture. Even after Mr. Cowan returned with the theatre data and viewpoint it has been difficult enough to get the studios to agree on cutting down their cameras. They feel that the twenty mil reduction from the original proposal definitely represents a concession to theatre considerations. They are willing to make the concession on area down to .600" however, for the sake of a general agreement and to secure a uniform practice.

The theatre circuits on the other hand are closer to the problem of proportion on the screen itself. They feel it is thoroughly worth while to get away from the square. While it is too bad that the steepest angles and the worst picture distortion are in the Class "A" and "B" houses, it is undoubtedly a fact and no remedy is in sight. Under these conditions and because of such other considerations as balcony cutoff, the theatre circuits have a lot of reason on their side to urge that the film image should tend toward the oblong and away from the square.

Granting that both area and proportion are desirable, the exact place to draw the line is a matter of opinion. The eighteen degree basis selected by the theatre representatives is just one point in the range of projection angles. Twenty degrees or sixteen degrees could have been selected by only a slightly different interpretation of the original data.

The 3 x 4 proportion is also a matter of artistic theory rather than engineering. Since the wide film promotion all proportions from the square to two by one have been cheered by one group or another. There is nothing sacred about the exact 3 x 4 even if it could be secured at all angles instead of just one.

So far as the mathematical difference between the .590" and the .600" apertures is concerned, it will show as about five inches on a screen sixteen feet high.

While you are of course familiar with them already, I have reviewed the above circumstances to emphasize that a uniform aperture practice necessarily and quite properly must be secured as an adjustment or compromise between area and proportion. This is clearly recognized in the letters Mr. Cowan brought back from Dr. LaPorte and other theatre representatives. While still preferring the assumptions on which the .590" figure was based they see that the studio area considerations also have weight and feel that agreement for a uniform practice is more important than an abstract argument over a few inches on the screen.

I think I can speak for the studio technical representatives in saying that we feel the discussion to date has been very valuable and constructive and that the studios and theatres will be better able to work together on future projects because of the present exchange of views and information.

Using Projection *in* Photography

By FARCIOT EDOUART

Part 2.

Readers will remember the article in the August issue of the MOTION PICTURE PROJECTIONIST dealing with the use of projection in photography. It was a fascinating lesson in studio technique but it also revealed that the skill and science of the projection room played an important part.

In this issue the article terminates with a discussion on the same subject between informed technicians and in more popular fashion, further explains the principles involved.

MR. AALBERG—I wonder if Mr. Edouart would say a few words about what is being done, or what can be done, to eliminate the hot spots so noticeable in the closer shots photographed by the projection process.

MR. EDOUART—That is our bugaboo in projection work—the hot spot. The efforts to do away with it optically have been centered in attempts to disperse the light to the edges of the screen without cutting down on any part of the source of light, and there have been various methods. Numerous screens have been developed and tested and some of course have been found better than others. There are screens which will do away with the hot spot but cut down on a certain amount of the definition, while others will cut down your illumination to such a degree that you won't get a photographically good composite shot. The sand blast glass screen has given us the best results to date.

Various methods have been employed for spraying the center of the screen and tapering it off to the edge so that the hot spot in the center is balanced with what light you have on the edges, which cuts down your illumination tremendously. However, I have seen some very wonderful shots —very beautiful shots made with screens treated by that method. But it is not always easy to tell exactly what you are going to get, especially when you do as many as ten or fifteen shots a day. You must be able to work fast. You have to get a screen that will be suitable for every type of shot that is scheduled for the day, and give you photographic value at every set-up.

At Paramount we have worked on various methods, but haven't succeeded in eliminating the hot spot entirely. We hope to. That is as much as I can say to you. Maybe there is someone else here who will tell us about it. I would like to hear more about it myself.

Mr. Hammeras could probably give us some dope on that, as I understand that his department at Fox first started this process. He might be able to give us some real information on how to eliminate the hot spot.

MR. HAMMERAS—Well, some of those samples you saw here to-night from our studio weren't recent shots at all.

During the last two or three weeks we have found that the sand blasting companies have helped us out a great deal in that they have a new process for treating the glass so that you get a finer grain—by sand blasting with flour. Before, they had a fine white sand which they were blasting with. The cuts made by this sand acted like prisms and the light would go through to be reflected on the center of these prisms, causing a hot spot or a fast falling off of the light on the edges of the screen. Since they now sand blast with flour the diffusion is much greater. It is like putting a Scheibe fog filter on a camera—the light spreads or diffuses. We have adapted some new condensors which we have installed on the projector which also throw the light to the corners of the screen without sacrificing any volume of light. We could always get a flat light on a screen but it would cut down our light 30 or 40 per cent. I think you will find that projection shots from now on will not have any hot spots. We have one cameraman in particular who is always telling us about the hot spots—he might be here to-night. I don't know—but after the last shots we made for him, he said, "You have finally eliminated it."

MR. PELTON — Mr. Hammeras, while you are down here may the chair ask you a couple of questions? What are the physical limitations in size of screen you will want to use?

MR. HAMMERAS—The limitation at the present time is about 20 feet, I think about 15 feet by 20 feet. We are working on a new idea at the present time, a projector which will throw a picture 30 feet wide and of proportionate height and with a flat screen without any hot spot. However, we will have to change the construction of both the camera and projector.

The developing of the film will be the same, but we will have to print in the camera. We will do that for the present until we can build new laboratory printing machines. In the next year I look for a picture background that will be 20 feet by 30 feet or 25 feet by 30 feet, which will give us additional scope in that we are now limited by the size of our glass.

MR. PELTON — What projection equipment do you use? What is the throw?

MR. HAMMERAS—At present it is 60 feet—which we find gives the best results. You see if we use a shorter focal length projection lens the rays are at such an angle that it causes a falling off on the edges, but if we can get more direct rays from the projector onto the glass by going back further it gives us a more even light, and then by putting the camera back as far as possible from the glass and using a 3 inch or a 4 inch lens we get a more even field to photograph and more exposure.

MR. PELTON—What focal length?

MR. HAMMERAS—3-inch camera lens and projecting with 4, 5, 6, or 8 inch projection lens. A 3 inch lens in the projector isn't very satisfactory, and 2 inch is almost impossible. That's where you get your hot spot. It starts shading on the corners and you can't get away from it. We have been experimenting all the way from a 1 inch up to an 8 inch and we find the longer focal length lens on the projector better. We also get better exposure and less grain by using a longer focal lens.

MR. PELTON—What amperage do you use in projection?

MR. HAMMERAS—There is a mirror type lamp which uses from 75 to 115 amps, and there is the condensor type that uses 190 up to 210 amps. The gas pockets in the carbons created at high amperage control the amount of current you can use. Too much current causes a flicker. That was one of the early problems of projection. To eliminate those gas pockets in the carbons we had to find a slow burning carbon. We went to the Navy Department for assistance and found that their searchlight carbons used on the battleships answered our purpose. We were given all the carbons they had at San Pedro, and used these in our experimental work, but when we came to make our first actual production shot, the Navy was out of carbons. You can imagine our embarrassment.

MR. PELTON—Assuming you can get a glass large enough to take a 30 foot width picture—about what throw would you use on a 22 by 30 foot glass?

MR. HAMMERAS—The throw will probably not be any greater than before—60 feet from the glass to the projector. However, that is not definitely worked out yet.

VOICE—I would like to ask whether the wide film cameras which have been put into storage could be brought out and used for projecting backgrounds with any degree of success?

MR. HAMMERAS—They could. At the studio we have fifteen or twenty—I don't know exactly how many we do have. The thought came to us soon after we first started experimenting but by that time they had taken out the wide film developing machines and printers and it would have been an expensive expenditure to replace them.

MR. PELTON—I might add that during this period of depression, the subject of wide film cameras is taboo.

VOICE—Has the yellow carbon lite ever been tried? Could I ask whether you use any other than white plain carbons now that there is an extreme sensitivity to yellow in the panchromatic film?

MR. HAMMERAS—Yes, at one time we used a red flame German carbon.

VOICE—Have you tried the yellow or red National Carbons.

MR. HAMMERAS—Yes. However we found that it is not a perfect light on account of the high intensity at which it burns, and because through the glass it doesn't make a great deal of difference, white red or yellow in exposure. We have even filtered our light for the new panchromatic film (which is more sensitive to yellow light), by using a light yellow filter on the projector, but it doesn't have much effect in added exposure. We are now using just a standard National Carbon.

VOICE—I would like to ask if you have tried to double sand blast the glass and what effect you obtained? Is there any increased value over the single blasting?

MR. HAMMERAS—Yes. We had two large glasses. One we sand blasted on both sides. That was before they were able to sand blast with flour to give the real smooth finish. Then we sand blasted one on one side and lacquered the back side and put a little color—white lead—into the lacquer. The difference between the two was that with the single blasted glass you get a distinct hot spot, while with the double sand blasted glass the image is given more diffusion and the hot spot disappears, so at present we are sand blasting our glass on both sides.

VOICE—Do you find your exposure cut down?

MR. HAMMERAS—It cuts down our exposure about 10 per cent, and when we got this new finish with the flour sand blast it cut our exposure about 20 per cent. To overcome this we enlarged the carbons in the mirror arc lamps. While we used to run 75 or 85 amperes, now we have to run at top, 115 to 120 amps.

MR. PELTON—Mr. Edouart, what throw do you use?

MR. EDOUART—Our average throw runs around 90 feet. We use various throws depending upon the size of the shots. We have set up for as many as four shots on one stage at one time. We may have set up closest to the projector a small shot through a little window on a small glass, such as an automobile shot. We may then pull that out and have already set up next in line an 8 by 10 foot glass, pulling that out afterwards, and so on.

MR. PELTON—The reason I ask these questions is that every studio seems to have a little different practice. At Metro-Goldwyn-Mayer we try to eliminate the hot spot by using the greatest throw and the longest length lens we can get. The throw is 106 feet and we use either a 5 inch or a 5½ inch lens with glass about 12 feet by 18 feet.

I think that the largest glass obtainable until some of the new plants open—I believe the Ford-Owen is shut down now—everyone has been asking for larger glasses, but until some of the big glass companies start manufacturing large plate, we can't get them. I am sorry there is no sample of the Metro-Goldwyn-Mayer process work here—however, their work is represented in the sound re-recording portion of the program.

The hot spot seems to disappear particularly due to the large focal length projection lens and the increase in throw. Physical limitations may not permit that in all places, but after some experimenting we decided that we shouldn't attempt this work in a stage under 200 feet in length, where we can allow 125 feet for projection and 75 feet for the cameras. As a matter of fact, we would like 50 feet more in length.

Is there anyone who wants to question the speakers as to how these different shots were made?

MR. CLARK—I noticed on some of those shots that you had a full figure, then you went to a waist figure, say, or a bust shot of two people talking. As you did, the background went out focus—just as it should do. Was the background the same as in the full length shot, or was it projected out of focus?

MR. EDOUART—No, it was projected just as sharp as the long shot, but optics will automatically take care of that just as it does in normal straight photography.

MR. CLARK—In other words, the glass is far enough away from the people so that that works out?

MR. EDOUART—That is one of the problems which has to be worked out on each set up. You have to figure the distance of the glass from your subject to give you the desired result. If you don't want a sharp background, your glass can be farther away. It is particularly desirable to have a sharp image on the background for close shots, you bring your glass closer and watch your focus, and you have it.

MR. PELTON—Mr. Edouart and Mr. Hammeras, will you each tell us whether you move your troupe to the process stage or move your apparatus to the set?

MR. EDOUART—Well, at Paramount, we are limited in stage space. We have one stage which is known as the transparency stage, and we try to do as much of our transparency process work there as we can.

While I think each studio has its own name for its own particular process, we call our work straight transparency shots or transparency projection shots. The name "transparency" is derived from the fact that the pictures are photographed by transmitted light. I should say that we do about 85 per cent of all our shots on the transparency stage. Frequently it happens that we have to work with a set which is very difficult to move. For these we have one particular equipment which can put on a Bell and Howell projector head and get absolutely perfectly stationary shots. We take this with our 12 by 18 foot glass right onto the stage.

We have experienced no difficulty so far, and I certainly hope we don't, because we can't get a cent of insurance on these glasses.

While we aren't limited to the transparency stage, we do prefer to shoot there. As all our equipment is there it is more economical if we can arrange it.

I might say that our work is limited by the length of our stage. The whole building isn't more than 135 feet long, which naturally limits us as to our throw. We would like to have a stage 250 or 300 feet long—maybe we'll have one some day.

MR. PELTON—And what is the practice at Fox?

MR. HAMMERAS—We have our largest glasses mounted on a dolly and can cart them around to any stage or wherever they may build the set. We can take either our 8 foot by 10 foot or our largest glass anywhere on the lot and put either one behind a window or porch or wherever they may want it.

MR. PELTON—What are your plans for the screen such as you mentioned a while ago—the 25 by 30 foot one?

MR. HAMMERAS—We will have to have a stage 200 feet long.

MR. PELTON—What do you intend to use for this screen—etched glass?

MR. HAMMERAS—No, we expect to use a gelatine screen. We have been promised by a New York manufacturer that we can have a screen made up 30 by 40 feet or as large as is necessary.

Screens made of woven materials cut down the exposure too much to make them practical.

We have made tests of different screens sent out from New York but the weave in the screen cuts down the light 50 per cent. Wherever there is a cross weave, there isn't a chance for light to transmit through that weave, which cuts down the exposure.

MR. EDOUART—May I ask something about the Metro-Goldwyn-Mayer method of working? What focal length lens are you using?

MR. PELTON—On projection?

MR. EDOUART—Yes.

MR. PELTON—5½ inch.

MR. EDOUART—And your throw is 125 feet?

MR. PELTON—106 feet. That is correct, Mr. Layton?

From an Expert's Note Book

BY R. H. MCCULLOUGH

GOOD projection and good sound reproduction is impossible if the equipment is in poor condition. It is advisable to replace worn parts from time to time. Do not allow your equipment to run down to a point where everything is worn out. This is false economy. Be positively sure that the sound reproduction in your theatre is as nearly perfect as possible. It is the duty of every projectionist to make an effort to keep all the equipment up to date.

One of the most important items in connection with the sound reproducing equipment is the care of wet storage batteries. Dampness and dirt on the battery tops permit the electric current to leak away, and this leakage may cause noise which wil lbe perceptible in the reproduction. Keep the battery terminals clean at all times. It is advisable to solder the battery terminals to the connecting straps so as to avoid corrosion.

Never allow the electrolyte to fall below the tops of the battery plates. Add sufficient water so that the electrolyte level is just above the tops of the plates. If the battery needs water, add the water just before charging. This allows the water to mix thoroughly with the electrolyte during the charge, as there is always some bubbling or gassing during the charge. Do not add water just before or during the presentation of sound reproduction.

Regular Inspection Essential

Projectionists have been advised from time to time to inspect the sound reproducing equipment thoroughly before the performance. The pick-up apparatus should be inspected carefully. When testing the horn receiver units, check each horn unit individually so as to ascertain positive operation. On many occasions it has been found that, after theatre patrons had complained about not being able to hear from where they were seated, a horn unit was dead, which criticism could have been easily avoided if the proper test had been made before the performance.

The exciting amp, or reproducer amp, pays a very important part in Movietone reproduction. Always see that the light beam is adjusted properly before starting the projector—otherwise, loss in volume or distortion will be the result.

Meter Fluctuations

When any of the meters fluctuate, connected to circuits on the sound reproducing equipment, this means trouble. The photo-electric cell amplifier and also the 41-A amplifier are so arranged that the filaments of the vacuum tubes employed in this amplifier, are wired in series and the filament brilliancy is accomplished by a variable resistance in conjunction with a meter which indicates the magnitude of current in the filament circuit.

The filament current should always be constant during operation. This means that the indication on the filament current meter must be steady. A fluctuating meter indicates that the filament current is unsteady, which may be caused by several defective conditions. First, it may be due to a poor contact at the meter terminals. Second, it may be due to a poor contact between the tube contact tip and the socket prong, caused by corrosion or a bent prong. Third, it may be due to corroded battery terminals; or, if a motor generator is employed to supply the filament current, it may be due to sparking brushes at the commutator or imperfect operation. Fourth, it may be due to one of the filament circuit connections which have worked loose either in the amplifier or in the circuit between the source of the filament current supply and the amplifier.

The plate current meter should also indicate a certain value without fluctuating. A fluctuating plate current meter may be attributed to several faults. First, it may be due to an overload condition. By overloading, we mean the application of excessive input and the inability of the tubes to handle this overload, which causes distortion. Second by a poor contact in the plate circuit, which will also be very perceptible by noise in the reproduction. Third, the improper operation of the unit, which supplies the plate potential, which may be a rectifier, batteries or motor generator set. Low plate current may be due to a defect in the tube, usually low electronic emission.

A Return to Fundamentals

It is our aim to make the sound coming from the sound reproducing equipment as nearly as possible an exact reproduction of the original sound. In transmitting sound by electricity the transmitted current is necessarily alternating in character. Even in those cases in which the vibrations are impressed upon a steady current, the operative or sound producing portion of the resultant current is alternating, and obeys the same laws as the simple alternating current.

The pitch of sound depends upon the period or frequency of vibrations of the fundamental note, and would be the same were all the overtones destroyed. The sound of the human voice is produced by the vibration of a thin elastic membrane at the top of the windpipe. The air from, the lungs, passing through a slit in this membrane, sets it into vibration and, as the tension on the membrane is varied, its rate of vibration changes accordingly—thus varying the pitch of the fundamental and its many accompanying overtones. With the aid of the mouth the fundamental tone and the overtones are mixed together in different proportions, and in this way the different vowel sounds are produced. To recognize and understand spoken sounds, it is not necessary that they should be loud. The faintest speech is readily understood if only it is clear. Poor tone quality does not always mean that the loud speakers, tubes or transformers are causing distorted output.

Some people, we are sorry to say, do not use the best judgment in the matter of controlling the volume in the theatre auditorium. We have pointed out many times the importance of rehearsing every production for the proper fader setting. A medium volume of sound is far preferable than too much. In many instances, if the volume is raised to a maximum, distorted sound will be the result.

Every theatre auditorium has a certain volume to fill. It is necessary that the sound reproducing amplifiers have the ability to deliver sufficient power to take care of any overload, when excessive volume is required—otherwise, distortion will be encountered.

Movietone equipment requires careful attention at all times for successful operation. Projectionists should be very careful, before starting the projector, to see that everything is ready for operation. It has sometimes happened that proiectionists do forget to close the switch, controlling the movietone amplifier and exciting lamp. After making the change-over the fader would be brought to the normal operating position but as soon as the error was noticed the switch was suddenly thrown in with the fader still in the normal position, which would produce a blast sound loud enough to startle the audience out of their seats.

If you have started the projector—brought the fader up to the normal operating position—and then discover that you forgot something, bring the fader to zero and correct your mistake. On many occasions, I have found that the projectionist had removed the sound gate and when starting the projector discovered his mistake and then endeavored to insert the sound gate in position without bringing the fader to zero.

It should always be remembered to bring the fader to zero, when encountering difficulties of this nature, and after correcting the trouble always advance the fader slowly, instead of quickly.

Points to Remember

Two other very important things in relation to the pick-up system are that you make certain, before threading film in to the second gate, that the sound band track is perfectly smooth and free from any and all deposits. Be positively sure that the loops are the right size, because if they are not a slight lack of synchronization will be the result.

An exciting lamp filament may possibly fail during the presentation of a Movietone subject. RCA equipment is equipped with a turret, which holds three exciting lamps and either one of these lamps is always ready to be swung into operating position providing the one in use would burn out. However, other sound reproducing equipments are now equipped with this feature, and it is necessary to always keep a spare lamp bracket with the exciting lamp properly adjusted, so that this unit can be installed within a few seconds.

It is imperative that the exciting lamp and bracket be so placed that it is ready for instant use—otherwise, a long interruption of sound will be encountered. Each Movietone projector should have its own spare exciting lamp bracket with an identification mark, indicating the projector in which it is to be used.

Line Voltage Fluctuation

Despite all that has been said and written by power companies and their associations, a positive 110-volt supply is a rare phenomenon these days. Many recording voltmeter charts have been received, and after studying these charts it has been found that the line voltage varies in many places from 85 to 140 volts. It has been mentioned in these articles before that a slight increase in voltage will often cause the vacuum tube filaments to deteriorate very rapidly.

It is by no means uncommon to have the normal 1,000-hour tube reduced to 100 or even to 50 hours on an over-voltage operation. When the line voltage is excessive the amplifier operates with abnormal primary voltage, which in turn is transformed into excessive voltages in the filter circuits, plate circuits and filament circuits. More serious still is the strain placed on the power transformers.

Insufficient Line Voltage

With excessive line voltage, the tubes glow brighter, but in the absence of a basis for comparison this may not be noticed, which results in short vacuum tube life. Most projectionists and engineers give very little thought to subnormal line voltage. Insufficient line voltage greatly reduces the efficiency of the amplifier. Vacuum tubes must be operated at a certain temperature for the necessary electronic emission.

Power tubes and rectifier tubes have been known to arc seriously and have been ruined very quickly due to insufficient filament voltage. It is obvious that great care must be exercised in having the correct filament voltage for all vacuum tubes, as carelessness in this matter will increase the operating cost.

Concerning Amplifiers

The amplifier with its associated apparatus is not a highly complicated electrical system. With careful study of every schematic of the equipment you are operating, the sound reproducing system will become more simple. The feeble impulses in the amplifier are amplified with the help of electrons rushing from filament to plate at a speed above ten thousand miles per second. This current is silent, but it carries with it voice or music which is heard as sound from the output or loud speaker.

If the original sound has been amplified perfectly, if none of the subtle variations have been lost from circuit to circuit and from tube to tube and if no extraneous effects have been introduced, the output will be faithful reproduction of the sounds impinging the microphone during the recording. Perfection of sound reproduction is not an impossible accomplishment.

Every projectionist is supposed to have an electrical education and this does not necessarily mean that he be an electrical engineer; however, if the projectionist is an electrical engineer he will be able to solve any amplifier problems regardless of his lack of familiarity with similar instances. It is very important to read references regarding trouble shooting as they will invariably make clear the problems which seem difficult to you and this will also solidify the explanations you have already grasped. All parts employed in the sound reproducing equipment are selected for their quality, and are such as to provide an ample factor of safety.

Handling Film

It is very important that motion picture film be handled with great care. We have been asked many times how long a sound track print will last. From my observation, the number of times a sound track print can be used depends entirely on the wear and tear and the care it receives. When the average print is used a few hundred times, it will become buckled and warped.

With the advent of sound and the installation of the perforated sound screens it was necessary to increase the screen illumination. This increased the heat at the projector mechanism aperture, which is entirely responsible for the buckling of film. The introduction of the rear shutter on the Motiograph and Simplex projector mechanisms, have eliminated the buckling of film—however, it will be some time before rear shutters are adopted generally by all theatres. When film becomes buckled and warped, it not only causes an in-and-out-of-focus effect on the projection screen, but it also prevents the sound track on the film from traveling over the sound aperture in a perfectly flat plane. If the film sound track is not held in a perfectly flat plane at the sound aperture, distortion will be encountered.

Scratches, Dirt, and Oil

Scratches, dirt and oil are very detrimental to the film sound track. We have found that if the film sound track surface is free from dirt, oil, sprocket tooth marks or deep scratches, the tonal quality of a film sound track will be just as good with the hundredth screening as at the first screening. There are certain rules in handling film which apply more forcibly to sound film. These apply especially to examination, splicing and rewinding. It is very important that film be inspected after each showing. Test each patch for complete adherence across the whole width of the film.

If the splice is weak, loose or otherwise poor, renew the splice immediately—otherwise, an interruption is likely to occur. The splicing of film with a sound track is a very simple process. Many projectionists do not block out splices made on sound track film. A plain splice no matter how well made, will cause a click in the sound reproduction as it passes through the sound reproducing mechanism. It is important to block out each splice at the sound track as mentioned before.

Rewinding Evils

Film should be rewound at a low speed with medium tension. Pulling and jerking must be avoided. Minor scratches on the emulsion of the sound track do not have any noticeable effect in the sound reproduction. If the scratch is wide and the surface dark the only effect this will have on the sound reproduction is a decrease in volume in proportion to the amount of the area of the sound track that the darkened scratch would cover. If the scratch causes an abrasion, removing the emulsion at intervals, a sputtering noise like that of radio static will be heard in the sound reproduction.

Projectionists should be very careful about oiling the projector mechanism—never allow surplus oil to flow on any part where the film travels. If oil gathers on the film sound track there will be a decrease in volume.

New Subjects for Standardization

By DR. ALFRED N. GOLDSMITH

EDITOR'S NOTE.—The Society of Motion Picture Engineers has taken the lead in creating and recommending standards in motion picture equipment. Before its leadership each manufacturer had his own specifications to which he held fast. This of course was wasteful, inefficient. It was in tune with the early times, when projection, for example, was considered of minor importance in the operation of a theatre. The Society has changed all that. It has the respect of all manufacturers and a succession of able leaders and an active membership has done splendid work. Dr. Goldsmith, the president of the Society, is an internationally known engineer and his comment here is instructive.

STANDARDIZATION projects, such as this proposed project on motion picture standards, grow logically step by step. Topics which initially seem of importance turn out to be not particularly susceptible to constructive and useful standardization; other topics which would not be considered as suitable for standardization on preliminary consideration afterward develop into topics of major importance. In the following it is therefore possible only to consider the general field of motion picture activities (so far as they are of technological character) and to mention some of the topics which might be suitable for standardization. The list must be regarded as entirely tentative.

Definitions

The terminology of the motion picture field is confused at present. Such terms as "blimp," "zoom," "pan," "tilt," "projection angle," "wow," or "flutter," and the like, are used without any official recognition. This situation requires correction so far as is feasible.

Film

Measurement of characteristics of the base of the film, dimensions of the film and of its perforations, study of film shrinkage and permissible maximum shrinkage, photographic sensitometric tests, measurement and specifications of "safety film," standard width of film of various types, standard containers for film for storage and for transportation, together with methods of preservation of films (for archives, etc.)

Studio

The acoustic treatment and illuminating methods for studios doubtless would permit of a considerable degree of standardization, both as to nomenclature, measurement, and specifications. Great varieties of lamps are used which are designated, for example, as "spots," "baby spots," "rifle spots," and so on. Light-diffusing media are used which are known by a variety of colloquial terms but are not definitely specified, for example, and in what is known as "oil diffusion," and presumably a wide variety of characteristics can be obtained under the same name. The acoustic characteristics of studios have not as yet been specified in any precise form in many instances, nor has measuring equipment for the purpose been adequately considered. Passing on to studio equipment, we find,

Cameras

The amount of significant noise produced in these devices at certain definite distances and in certain definite directions (in free space), the tolerances in the dimensions of the various working parts, the tensions and pressures in various parts of the mechanism, the dimensions of the magazines and of the magazine hubs, the take up tension, and numerous other characteristics of cameras require study for possible standardization. The mode of mounting the lenses, the possibility of standardizing focal lengths and apertures of lenses for motion picture practice, standardization of shutter aperture, definition of tripod arrangements and nomenclature for devices permitting moving shots (traveling trains, and the like), require consideration. Measurement of the effectiveness of camera-silencing inclosures is required.

Recording Equipment

Microphones, amplifiers, acoustic reflectors, recording equipment, and sound track measuring equipment fall under this heading. Numerous characteristics of these devices are measurable ,might be specified to advantage, and may ultimately be suitable for standardization.

Re-recorders

These are used for the introduction of modification of sound effects, and are rapidly becoming an important part of the studio technic. They are used for recording from 35 mm. film to 35 mm. film; and are now being produced as well for re-recording from 35 mm. film to 16 mm. film. The overall frequency and volume characteristics of these devices, the amount of acoustic distortion that they produce, and certain other factors are of major importance.

Photographic Printing

Classification of types of equipment of this sort (continuous and step printers, optical reduction printers, contact printers). Permissible speed variation. Definition of maximum desirable operating speed. Specification of illumination of the printing surface.

Laboratory Processes

The development of film is now carried out in various ways by automatic machinery. The terminology requires study and certain of the processes require precision measurement and definition. For example, methods of measuring developer concentration or speed, measurements of the effectiveness of processes for "hardening," or otherwise preserving film, and the like.

Exchange Equipment

Films, after being returned from the theater, pass to the exchange where they are inspected. Inspection methods have never been definitely specified or defined. Dimensions and mechanical specifications, as well as strength tests of reels and containers used by exchanges require consideration, both for nitrate and safety stock.

Theater Equipment

Projectors have numerous dimensions requiring standardization. The tension and pressure at various points of the mechanism, magazine dimensions, safety devices, contrivances to protect the projectionists' eyes from undue glare, take-up tension, and the like, may all be considered for standardization. Screens (both of the continuous type and of the perforated "sound-transmitting" type merit study for standardization of their reflection characteristics and specifications thereof. The re-surfacing of screens as they become warped brings up a similar series of problems. The amplifying and loud speaking equipment gives rise to the usual series of electro-acoustic standardization problems ending with the frequency characteristic, distortion characteristic, and space distribution of the output of the loud speaker system.

Miscellaneous

Such fields as color photography require study. The various processes have never been satisfactorily defined nor have the various forms of cameras, lenses, processing equipment, and projectors been put on a suitably precise basis. Three-dimensional pictures require definition. Frequency systems which give perspective impressions are classified as three-dimensional or "pseudo-stereoscopic." A considerable amount of confusion exists here on terminology.

Aluminum Horn Announced

THE first size in a full series of all-metal trumpet horns has just been offered the sound projection trade by the Fox Engineering Company, Toledo, manufacturers of horns and high-powered electro-dynamic units.

While the tone characteristics and physical requirements of the perfect amplifying horn have long been recognized by sound engineers, the actual attainment of these characteristics has been a matter of slow and painstaking development. All-metal horns are not new, but an all-metal horn that is entirely free from rasping and vibration noises is an achievement that will be welcomed by every sound engineer in the country.

This new horn is of conventional trumpet design and has consistently shown, under all conditions, a clear, bell-like tone that has surprised and pleased every engineer that has tested it.

Notwithstanding the fact that these horns are 6 feet long, and have a bell diameter of 32 inches, they are of spun aluminum and free from lateral joints or seams. This construction makes possible a definite radio uniformity that accounts for its fine tone. Aluminum is not only an ideal medium from the standpoint of resonance and purity of tone, but its light weight is an appreciated factor in many instances. It is easy to set up and take down for temporary use, and when knocked-down into its two integral parts is extremely easy to store and ship.

These horns are entirely free from the influence of atmospheric and moisture conditions and are almost indestructible in normal use. Weight is only 12 pounds.

The outstanding application is for exterior use where weather conditions are bad, but their compactness, light weight, and fine tone quality meet every condition of auditorium and theatre work.

Square D Calculator

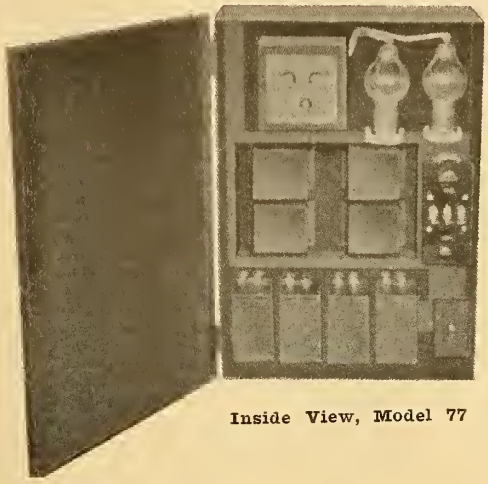
THE Square D Company, Detroit, Michigan, has just introduced a new wiring and motor data calculator of unusual design and of particular interest to inspectors, electrical engineers, contractors, salesmen, estimators, wire-men, etc.

This device is compact in size, 7" long, by 3½" wide by ¼ thick, fits into a neat case and can be easily carried in the pocket. With it the electrical man has at his finger tips all wiring and motor data, eliminating hours of figuring and providing him with accurate data at the turn of one of three dials.

ARE YOUR BATTERIES WEARING OUT?

a FOREST RECTIFIER

Solves Your Battery Problem Giving You Better Operation At Less Expense



Inside View, Model 77

Forest rectifiers save current, are efficient, supply unfailing non-fluctuating current, require no attention or attendance, and are always ready for service. They eliminate all "A," "B" and "C" batteries.

Model 77 supplies 7½ amperes to exciter lamp and 1 ampere to amplifier filaments. We make a rectifier for every direct current requirement on sound equipment.

A BRAND NEW FOREST RECTIFIER

A greatly improved rectifier—the result of years of experience and research is now ready. These new Forest Rectifiers will absolutely out-perform anything ever offered before. Inexpensive to own, economical to operate, easy to install and positively quiet in operation.

Available in Model No. 30 up to 30 ampere capacity for one projector. Model 25-25, up to 25 amperes to one projector and an additional 25 amperes to second projector during change over. Model No. 45, up to 45 amperes to one projector available for either single or three phase A.C. current.

Model No. 6, up to 65 amperes, and Model No. 10, up to 100 amperes, both for one projector, are now available in three phase A.C. current only.

Model No. 15 is portable, 15 ampere capacity.

Model No. 20 is stationary, 20 ampere capacity.

Front View, Model 25-25

Write for bulletins

FOREST ELECTRIC CORP.
Newark New Jersey

An Engineer Tackles Noise Problem

By S. K. WOLF*

BECAUSE of the intimate relation between noise and movement the machine age, in addition to major sociological and economic changes, is characterized by an amount of noise new in human experience. This is especially evident in the present motor age where our urban life with its strident, insistent hurry has noise as a predominating feature. It is also true of our factories; the impressionistic representations of industrial scenes of new thought painters should have their counterpart in weird synthetic sound patterns symbolic of the "hum of industry." A sensitive person viewing our civilization might be led to conclude that there exists a squalor of noises in a world of mechanical splendors.

Within the past few years there have appeared signs of awakening consciousness. The first eager acceptance of mechanical appliances has been tempered by a demand for silent operation in a public reaction that has been reflected in engineering circles. The engineering version of this reaction is that with which I shall be concerned here. Because of it, such typical branches of engineering as civil, mechanical and communication have had to turn their thoughts to a new field which may be called noise engineering.

Noise engineering has to do with noise in all its phases. generation, transmission, effects on mechanical and human equipment, measurement, analysis, and suppression. It is both preventive and curative in its practice, the ultimate purpose being the elimination of all harmful noise and vibration. Some of the high lights of this new field will be discussed here.

Noise we define as any undesired sound. This definition emphasizes the psychological rather than the purely physical aspects and correctly so. The physical properties of noise and music tones are very much the same in regard to measurement, transmission and absorption, hence distinction cannot be made too sharply. Various types of sound wave forms range from the simple pure tone to the highly complex street noise.

Since we are concerned with the human elements in noise reduction work, it is necessary to examine brifly psychological and physiological effects of sounds. Subjective auditory response to sound stimuli is logarithmic in character, i.e., the Weber-Fechner law of sensation which applies to the other senses is true for hearing also. There is some deviation from the logarithmic relation especially at the higher and lower frequencies as the hearing mechanism is non-linear with intensity. It is also non-linear with frequency. The ear is a great deal more sensitive to low intensities from 1000 to 4000 cycles than it is at others. As the intensity is increased, the response with frequency becomes more uniform.

In addition to auditory sensation, noise also produces other less tangible effects. There are psychological elements like annoyance and mental fatigue; e.g., it is thought that pure tones of high frequency are more annoying than pure tones of low frequency of equal loudness. Recent investigations have shown harmful physiological effects of noise on brain pressure, digestive system, body recovery during sleep, etc. These consequences cannot be elaborated upon here but the noise engineer must be familiar with them in order to determine what characteristics of undesired sounds require the most immediate attention.

Noise studies proceed most rapidly when measurement of noise is feasible. Sound meters are invaluable in eliminating the human element and furnishing reliable data concerning the composition and magnitude of noise. Several types of instruments with novel design features have been devised and they shall be briefly mentioned here. The intensity may be measured either in dynes, or the logarithmic unit, borrowed from the transmission engineer, the decibel.

A comparatively simple meter is one designed to measure acoustic power directly. This type is not common inasmuch as usually we are concerned with the sensation value of a sound. A more common sound meter has a frequency weighting characteristic similar to the loudness level curve at 40 db. To simulate the ballistic characteristic of hearing it is designed to give maximum response only for sounds of more than a fifth of a second duration. The maximum intensity for which it will function is about 500,000,000 times the minimum, an enormous range for an instrument, but not so great as our ears can accommodate. The ideal for this type of meter, complete correspondence between its readings and the response of the average human ear is far from realization. Nevertheless the instrument is most valuable in engineering studies on noise and noise reduction.

Another type of instrument is the harmonic analyzer. Applied to noise the name is something of a misnomer for the meter will indicate components having no harmonic relation to each other. Such analysis is desirable to aid in locating the sources of troublesome components. The analysis may be broad, i.e., the entire acoustic spectrum may be divided into 3 or 4 parts; or separation between components relatively few cycles apart may be had. The meter is based on the heterodyne principle in order to secure uniform and high selectivity, with electrically resonant detector circuit. It is interesting to note that today mechanically resonant elements are sometimes employed in place of electrical circuits in such analyzers.

Since noise in modern life is, in one sense, largely due to the engineer, it seems fitting that the engineer should now concern himself with ameliorating existing conditions. The program adopted by the noise engineer to war on noise may be classified into fields related to the several branches of engineering. The first principle of the noise engineer, avoidance of its generation, is highly applicable in the motion picture and other fields. If our machines can be made silent in operation, the first great step forward

---

* Director, Acoustic Consulting Service, Electrical Research Products, Inc.

Erpy Head Sees Talking Pictures As Inspiration of Future Generations

MR. J. E. OTTERSON, President of Electrical Research Products, Inc., in a speech before a group of motion picture trade paper people recently declared that talking pictures will be the inspiration of mankind. In his own words:

"I regard talking pictures as, in reality, a means of communication, whereby the art and inspiration of great actors, teachers, preachers, and statesmen may be carried from the sphere in which they move, to the ever widening sphere of world interest from the metropolis to the hamlet, from the great university to the country school-house, from the cathedral to the parish church, from this generation to future generations who may find in the better understanding of our lives, our achievements, and our dreams, of our personalities and characters the inspiration and example that will lead them to a still higher civilization in the days to come."

will be realized. Factories, offices, theatres and even homes can be quietly peaceful compared to present conditions. The transportation fields offer great possibilities in this respect. Automobiles, subways, trolleys and aeroplanes are all noisy but are all undergoing study and improvement. The second principle of the noise engineers to avoid sound and vibration transmission, is obviously important to the construction man and also to the mechanical engineer. It is the duty of architects and builders to supply substantial sound-proof buildings. To keep out noise, homes of the future may employ windows for light and observation only, air being obtained through auxiliary, sound-proof inlets. The third principle, to absorb sound, has its application after other principles have been tried. The ventilating expert uses it to produce silent ventilating ducts and window attachments, and there are other similar uses for diminishing the intensity and sensation value of noise.

How is the above program being carried out at the present time?

I feel that I am not being too optimistic when I say that progress is being made all along the line. Automotive engineers are giving us the silent second and vibrationless motors and motor suspensions. Recently in New York City the Board of Transportation had us perform for it an extensive noise survey of subway and elevated lines. The study included the consideration of the type of roadbed, type of tunnel construction, type of elevated structure, type of rolling stock, etc., all with the thought that each link should be designed to achieve quiet conditions.

The noiseless typewriter is comparatively familiar to all but even it is undergoing modification to make it more silent. In talking picture work we have introduced the so-called noiseless recording to amputate the highly unnecessary scratch from film entertainment. Manufacturers of household equipment, such as electric refrigerators, have catered to the public demand by producing quiet machines.

And so on. I have tried to outline some engineering aspects of a large scale program for the elimination of noise. The program is an idealistic one but nevertheless admits of practical realization.

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO., 844 So. Wabash, Chicago.

Academy Awards Announced

Appointments to the 1932 Committee of the Academy of Motion Picture Arts and Sciences on Annual Awards for achievements in motion pictures were announced recently by President M. C. Levee of the Academy.

David O. Selznick is chairman of the committee, which includes three representatives for each of the five Academy branches, as follows: Actors—Edward G. Robinson, Frederic March and Jean Hersholt; Directors—Ernst Lubitsch, Lewis Milestone and King Vidor; Producers—David O. Selznick, Louis B. Mayer and Walter Wanger; Technicians—Cedric Gibbons, Carl Dreher and Ralph Hammeras; Writers—Oliver H. P. Garrett, Frances Marion and Al Cohn.

The Academy Awards of Merit have been presented annually in the form of gold statuettes for the past five years for distinguished achievements in the motion picture professions during the twelve-month period ending each July 31.

Outstanding recognition of accomplishments in the motion picture arts or sciences on a par with the Nobel and Pulitzer prizes in other professions, the Academy's Awards are unique in that the selections of the winners are made by active participants in all branches of the industry through elections held amongst the Academy's 750 members, rather than by a board of judges. The Awards are presented at an annual banquet held early in November.

Winners of the 1930-31 Awards were: Best Performance, Actress, Marie Dressler in "Min and Bill"; Best Performance, Actor, Lionel Barrymore in "A Free Soul"; Best Direction, Norman Taurog for "Skippy"; Best Produced Picture, Radio Pictures for "Cimarron"; Best Original Story, John Monk Saunders for "Dawn Patrol"; Best Adaptation, Howard Estabrook for "Cimarron"; Best Photography, Floyd Crosby for "Tabu"; Best Art Direction, Max Ree for "Cimarron"; Best Sound Recording, Paramount-Publix; Scientific and Technical Achievements, for Noise Reduction Recording Equipment, Electrical Research Products, Inc., and RCA Photophone, Inc., and RKO-Radio Pictures; for Super-Sensitive Panchromatic Film, Dupont Film Manufacturing Company and Eastman Kodak Company; Honorable Mention for Synchro-Projection Composite Photography, Fox Film Corporation.

Color Films Back

There is talk that the vogue of color pictures is coming back. It may have been started by Walt Disney's color cartoon, one his series of Silly Symphonies which are so popular. It will soon be seen in the country's theatres.

S. O. S. Corp. Wins In Business Contest

In a nation-wide contest, participated in by thousands of the country's largest organizations, and sponsored by the General Electric Co., the motion picture trade received very favorable recognition.

In the sales campaign, which was not limited to any particular field, several of the industry's better known concerns were near the top. Results were based upon the increase in sales for the last quarter of 1931, as compared to the same period in 1930. As an indication of the general trend of business, the reports shown were quite encouraging.

In the Metropolitan District, the outstanding leader and winner of the grand prize in that division was the S.O.S. Corp., of 1600 Broadway, New York. This company showed the astounding gain of over 400% in its business during the contest. The officials of the concern feel highly elated, because it reflects the great efforts which they have been making during the past year.

Monster Screen Installed in New York Paramount

The largest Chromolite Sound Screen ever made was recently installed in the Paramount Theater, Times Square, New York City. The picture surface of the screen measures 31-0x43-0, a total of 1,333 square feet.

A full length picture of a man filling the screen from top to bottom will show him as about thirty feet tall; each of his shoes will measure about five feet in length; his middle finger will be about nineteen inches long; his eye will be larger than an average face; the mouth from corner to corner will be nine inches wide. He will measure across the shoulders approximately six feet; a button on his coat will be about three inches in diameter.

A closeup of a face filling the screen will be about thirty feet from chin to top of the head. Each eye will be about forty inches long; the mouth about eighty-four inches from corner to corner; the nose will be about one hundred inches long.

In spite of the immensity of these figures, the optical illusion is such that the audience will not be aware of the tremendous size of the figures. They will seem perfectly natural to the patrons viewing the picture.

WATCH
for special Anniversary
Issue of
MOTION PICTURE PROJECTIONIST
OCTOBER 1st

A Service Engineer Makes His Rounds

By IRVING WEISS

Last month we followed Service Engineer Smith on his tour of inspection. We left him in a theatre auditorium listening for possible defects in the sound. While at this phase of his inspection an usher informed him that there was a telephone call from his office.

Part 2

AS Engineer Smith made his way to the telephone he wondered if this might mean trouble in some theatre. Smith soon had the answer to his reflections. A theatre nearby was without sound and needed the services of an engineer immediately. The manager's relief on seeing him was obvious. "Hello Smith! Sure glad to see you. Can you clear our trouble quickly? Our patrons are becoming a bit impatient because of the delay."

Smith went directly to the projection room. A quick glance at the amplifier equipment showed him that the trouble did not lie there. Smith and the projectionists engaged in the following conversation:

Smith:—"When did you first notice the loss of sound?"

Projectionist:—"We lost sound during the change-over from machine No. 1 going into No. 2."

Smith:—"Does the condition exist on both machines?"

Projectionist:—"Yes. When we discovered there was no sound on machine No. 2, we immediately stopped projection and transfered the reel to No. 1 machine, and upon starting, the same condition of no sound existed."

Smith:—"What did you do when attempting to rectify the trouble?"

Projectionist:—"We checked the tubes in the various amplifiers, the photo-electric-cells and exciting lamps along with fuses. We could not find anything and therefore requested the manager to have an engineer sent here."

The projectionists were quite capable, and by their description gave Smith a fairly good idea as to where the trouble might lie. He proceeded to the non-sync turntable to inspect the fader and the input of the amplifier. The test confirmed his suspicion that the trouble was somewhere between the fader and the amplifier, for Smith was able to reproduce music by means of the non-sync equipment.

Smith's next step was to ring out the leads running from the fader to the amplifier. This test showed a ground of the speech leads running from the fader to the "A" box and then to the input of the first amplifier. The actual ground was found at the fader junction box where this particular speech lead had been subject to vibration, causing the lead sheath of the wire to cut through the rather thin rubber insulation. It took Smith just a few seconds to strip the lead back and tape the damaged insulation. Another few seconds were spent on making a working test and then he permitted the projectionists to continue the performance.

The time taken by Smith to "clear" the trouble was approximately ten minutes. He decided he would kill two birds with one stone by making his regular routine inspection of the theatre.

Smith, however, was not the master of his own destiny. In the manager's office was a message instructing him to proceed to another theatre immediately.

And now we have Smith working on a damaged amplifier at this new location. He found a plate transformer burned out in the 42-A amplifier. It was due to a shorted filter condenser. Smith tested the transformer by means of a voltmeter and a battery in series. He disconnected the wires from the transformer itself and located the burn-out on the secondary or high voltage side of the transformer.

To secure a replacement of this transformer would entail a wait of approximately an hour and a half. This, of course, would mean refunding admissions or issuing passes to the patrons. He realized that this called for action—something must be made to substitute for the damaged transformer. Smith's solution for the problem was a very simple one. He asked and the manager secured eight forty-five volt batteries from the nearest radio store.

When these batteries had been delivered Smith went to work. He connected the batteries in series. This gave him a total of three hundred and eighty volts, which was just a little short of the voltage supplied by the rectifying system of the 42-A amplifier. He then disconnected the lead running to the plus mark on the milliameter. This removed the defective rectifying system, electrically, from the amplifier. The next step was to take a lead from the plus side of the bank of eight batteries and connected to the plus side of the plate milliameter. Then he connected another wire from the plus of the batteries to the three hundred and ninety volt terminal of the 41-A amplifier. This permitted the amplifier to receive its voltage which it ordinarily would have gotten from the common rectifier of the 42-A amplifier. The next step was to connect the negative side of the batteries to the terminal marked minus on the amplifier. Smith now had a substitute for the burned-out transformer.

The system was ready to put into operation. It was accomplished by turning on the 41-A, the 43-A and the 42-A, with the exception that the 42-A snap switch was placed on *"Fil"* position (*"Fil"* meaning filament). The reason for placing the snap switch of the 42-A on filament position only is due to the fact that the batteries have substituted the plate transformer. Consequently, making it unnecessary to supply any AC input to the damaged transformer.

As soon as the amplifiers were turned on Smith made a preliminary test for sound, found it operating and permitted the projectionist to proceed with the show.

In the manager's office Smith was praised for his satisfactory services. He replied that it was part of his job but that real credit should go to the projectionists for their excellent cooperation without which the work could not have been done so quickly.

On calling his office Smith was instructed to go to Marcy's Presentation Theatre which was having trouble with its public address system. The audience could not hear a famous musical comedy star who was playing there. She could not be heard beyond the fifteenth or sixteenth row of the orchestra.

Smith gathered his tools and proceeded to this new assignment. Upon arriving at the theatre, he made his way backstage and inspected the P.A. system. It was new and utilized the latest types of dynamic microphones. Inspection showed that the equipment was in operating condition and needed but few corrections to enable it to function properly. He connected the microphones and set the gain control to its maximum operating setting, which was at the point where feedback could not occur. He instructed the stage electrician as to the proper manner of operation. Smith then went into the theatre auditorium and waited until the star made her appearance. Her voice was amplified tenfold, and yet was soft and easy on the ear. Smith was satisfied that the system was now functioning properly.

Smith glanced at his watch which verified the feeling of hunger he was experiencing. He decided to have his dinner and then go home to rest until the break of the show at the Majestic theatre where he was due to report for a special assignment that night.

We leave Smith on his way home and wonder whether or not he will keep his scheduled engagement that evening. Perhaps something in the way of an emergency will arise to prevent him from keeping his appointment. Let us see what happens to him in next month's issue of the MOTION PICTURE PROJECTIONIST.

Who Is Responsible?

By A PROJECTIONIST

FILM damage is a question of great importance. It is fast growing into a vexing problem and one that I feel should be met fairly so as to check a bad situation that seems to be growing continuously worse.

Just who is to blame for the situations that are happening so frequently in motion picture theatres in every part of the country? I mean those things that interrupt the performance by unexpected sounds and discords that appear during the presentation. It is true that the immediate cause is easily traced to the projection room, but is the projectionist responsible? It seems to be the habit of the manager and those in charge of the various exchanges to hold the projectionist wholly responsible, where in many instances the blame should be placed elsewhere.

I believe that it is admitted that a well regulated exchange should project and carefully inspect every foot of film before it is delivered to a theatre. Is this done?

In many cases the exchange does not inspect the film thoroughly and passes it on to the theatre in a faulty condition.

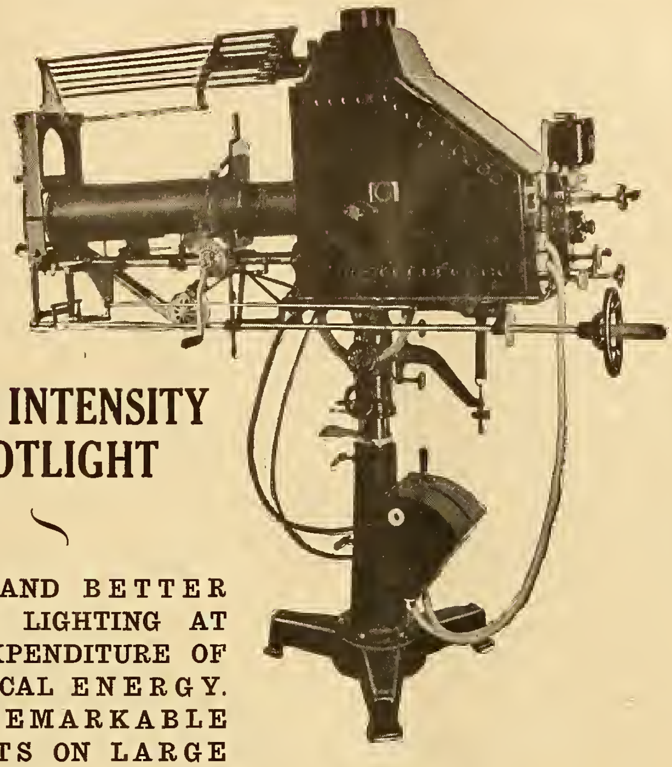
When the projectionist has time to check and inspect his reels he may discover these imperfections and correct them before putting the film on the projector. When he has no time, trouble results.

Many times the projectionist will call the attention of the owner or manager of a theatre to the fact that certain parts of the equipment are worn and need replacing. However, the manager takes it upon himself to pass judgment upon these parts. He believes that they will continue to operate for an extended period of time and fails to purchase the requested items. The manager believes that this constitutes economy.

But he is really guilty of wilful neglect because these worn parts will eventually cause some form of film damage.

This article is not written to excuse projectionists from their given responsibility. These unfortunate occurrences are often traceable to carelessness or lack of knowledge on the part of the projectionist. But upon careful study of the subject my conclusions are that the major portion of these occurrences are not directly chargeable to him.

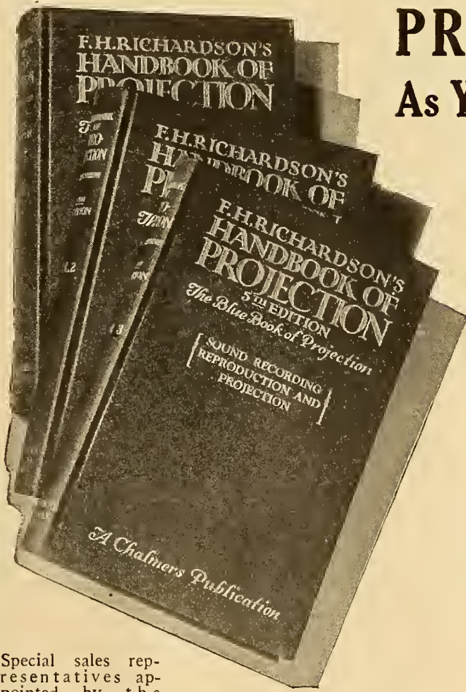
A careless operator who fails to inspect his film and by so doing allows particles to accumulate and harden causing damage, is no credit to the profession. He should be severely criticised by those men who have by their helpful and scientific application to the science of projection created high standards.



HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY. MOST REMARKABLE RESULTS ON LARGE STAGE SETS. - - - -

HALL & CONNOLLY, Inc.
24 Van Dam St. New York, N. Y.
H&C INC.


F.H.RICHARDSON'S HANDBOOK OF PROJECTION
F.H.RICHARDSON'S HANDBOOK OF PROJECTION 5TH EDITION The Blue Book of Projection
SOUND RECORDING REPRODUCTION AND PROJECTION
A Chalmers Publication

PROJECTION
As You Must Know It

This 5th edition HANDBOOK OF PROJECTION by F. H. Richardson is known the country over. It has been the means of making thousands of projectionists masters of their profession. Remember, Richardson gave the "operators" of 1910 the first projection manual ever written.

Now 3 Volumes

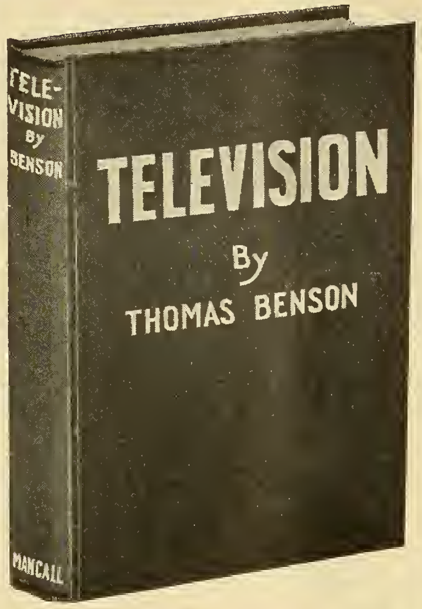
Over 1,400 pages of the most vital kind of information. More than 400 illustrations. Each volume carries the special Richardson question and answer index—the greatest feature any projectionist could wish to have.

If your future is linked with projection make it brighter and securer by owning and studying this finest of projection libraries.

The complete set of three volumes mailed to your door upon receipt of check or money order for $10.25.

Special sales representatives appointed by the Chalmers Publishing Company, publishers of the Handbook on Projection. - - - -

MANCALL PUBLISHING CORP.
7 West 44th Street New York City



BE PREPARED!

TELEVISION
For the
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today.

NOW
$1.00
Final Edition
Only Few Copies Left
ORDER IT TODAY

Some of the Contents

- —Elements of Visual Communication
- —Light Sensitive Cells
- —Scanning Methods
- —The Television Signal and its Amplification
- —Transmission Channels for Television
- —Light Sources for Television Reception
- —Reproducing the Image
- —Synchronizing Methods
- —Stereoscopic and Color Television
- —Experimental Television

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th St., New York City

Enclosed find money order for $1. Please send me Benson's Television.

Name............................

Address............................

City and State............................

Theatre............................

W. E. Sues To Decide Ownership of Equipment

THE question of whether a patented article can be used without authorization from or compensation to the holder of the patent is raised in an unusual suit that has just been brought by the Western Electric Company against the operators of the Gibbs Theatre, Youngsville, Pa.; in the U. S. District Court, Western District of Pennsylvania.

While the Western Electric Company is primarily engaged in the manufacture of telephone equipment it has become an important factor in the motion picture industry through the development and manufacture of the Western Electric Sound System for recording and reproducing talking pictures, which is now installed in more than 8,900 theatres throughout the world.

Under the terms of its contracts the projection equipment is leased for a period of years to an individual theatre. A transferral of equipment to another theatre, according to the contract, can be arranged only by mutual consent.

The suit that has just been filed arises from the fact that a Western Electric equipment was installed in the Strand Theatre, Greensville, Pa. When the operator filed a voluntary petition of bankruptcy, the landlord seized the equipment. It was sold to the landlord's trustee at a sheriff's sale to go toward paying arrears in rent owed by the theatre operator.

Subsequently it was bought by A. W. Gibbs and installed in the theatre he operates in Youngsville.

Western Electric's suit claims infringements of 29 patents. It contends that the equipment was leased to the Strand Theatre and licensed for use in that theatre only and that its unauthorized use in another theatre constitutes a violation of the Western Electric Company's patent rights.

The action is the first of its kind to which Western Electric has been a party and involves some distinctive legal points, so that its outcome will be watched with close interest both by the motion picture industry and by members of the legal profession.

New Markets

The attention of the motion picture industry is being turned toward the commercial and school field with a view to capitalizing on the interest exhibited there in motion pictures and motion picture' equipment. It is said that another few years will see pictures made especially for these markets. Equipment especially built for non-theatrical use is already in existence and is selling widely in the commercial field. Most of it is of the portable type.

RCA Victor Active in Installation Field

During the three months that have elapsed since the Photophone Division of the RCA Victor Company announced the introduction of its Super Size all AC operated and Large Size all AC operated sound reproducing equipments, which developments followed the highly successful performances of its Special Size and Standard Size all AC operated units, the company has replaced a greater number of unsatisfactory installations than in any six-months' period in the past three years, according to information just released by the commercial department in Camden, N. J. Contracts accepted in May far exceeded expectations and indications point to even greater business in June.

"All AC operated sound reproducing apparatus," said E. O. Heyl, manager of the Photophone Division of the RCA Victor Company, "has solved many problems for the exhibitor, particular through the elimination of the troublesome battery and motor generator,—two units that obviously require constant attention. The installation of the AC operated equipment compared to other types is as simple as plugging a modern radio receiver into a lighting outlet. Simplicity of operation is self-evident. To start or stop the entire system only one switch is manipulated. With the exception of projector sound head attachments no rotating machinery of any sort is required.

Reproduction is of the highest possible quality obtainable with present-day recordings. Each of the component units is fabricated of excellent materials, sturdily constructed, and of ample capacity to insure continuously uninterrupted operation, so important in the theatre. AC operation along with the delivery of eminently satisfactory sound, has been more responsible for the disappearance of wrinkles in exhibitors' brows than anything else since they began to realize that quality sound must be maintained to bring patrons back to the theatre."

Mr. Heyl also said that exhibitors had expressed great satisfaction over the assurance that the Photophone loud speaker employed in connection with the operation of the AC operated apparatus, would faithfully reproduce the so-called "wide-range" recording without modification or adjustment. These speakers were designed to reproduce sound frequencies ranging from 60 to 9,000 cycles, and are the only speakers on the market that will announced reductions in their service

The RCA Victor Company recently charges, which saving amounts to considerable sums, and has proved mighty helpful to the exhibitors during these hard times.

THIS BOOK IS A CHALLENGE TO EVERY PROJECTIONIST IN AMERICA

More Miehling books have been sold to projectionists than any other. . . . There have been others since Miehling's book was brought out . . . and all at a higher price . . . but Miehling's still remains as the only book written by a projectionist for projectionists. . . . That is why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of ALL sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

NOW ONLY

$2

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer, of sound equipment and practicing projectionist.

•

**519 pages . . . .
Completely indexed
Fully illustrated.**

Do Not Delay! Fill in this coupon and forward to us at once with your remittance. Do it now!

MOTION PICTURE PROJECTIONIST
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $2.00.

Name..

Address..

City and State..

Position..

Theatre..

★★★★★

FIVE STAR FEATURE

NATIONAL PROJECTOR CARBONS

★ **Pre-Cratered High Intensity Carbons**
Burn in more quickly and smoothly. Assure clean burning when arc is struck on a new carbon.

★ **New National S R A Carbons**
Afford the greatest volume of light available from the low intensity mirror arc projector.

★ **13.6 mm x 22 Inch High Intensity Carbons**
Give one more double reel per trim—3 less carbons per twelve-hour day—no increase in price.

★ **85 Ampere 9 x 20 High-Low Carbons**
Improvements in the 9 mm x 20 inch National "High-Low" White Flame Projector Carbon permit operation at arc currents up to 85 amperes.

★ **Low Prices**
Price reductions, effective since the first of the year, save the theatre owner 5 to 28 per cent on carbon costs. *Two satisfied patrons pay for the carbons used at each performance.*

NATIONAL
PROJECTOR CARBONS

. . . *Sold exclusively through distributors and dealers. National Carbon Company will gladly cooperate with the producer, exhibitor, machine manufacturer or projectionist on any problem involving light.*

NATIONAL CARBON COMPANY, INC.
Unit of Union Carbide UCC and Carbon Corporation
Carbon Sales Division . Cleveland, Ohio

BRANCH SALES OFFICES: NEW YORK PITTSBURGH CHICAGO SAN FRANCISCO

MOTION PICTURE PROJECTIONIST

NEW FIELDS FOR THE PROJECTIONIST

FOR a long time—since the beginning of motion pictures in fact—projectionists have viewed the motion picture industry as their sole sphere of activity.

OCT 25 1932

Today new vistas are opening up. The sphere of activity has become almost limitless. Projectionists have so far been unable to take advantage of this because the production of appropriate films has not yet caught up with the need and the demand.

I am referring to the non-theatrical fields. Clubs, churches, public and semi-public auditoriums, industries and schools are only a few of the places that are now using and can use more films appropriate to their particular needs. Of all these the school field is the largest and the most important—that is, pictures have a definite and useful work to perform there.

One of the largest experiments in school films is now being conducted by the University of Chicago together with Electric Research Products Corporation (Erpi). This experiment is in the form of actual films made for class room work and based on study subjects. According to President Hutchins of the University, these films will be used in colleges and high schools and finally will percolate down to some 2,200 primary schools which will participate in the experiment. If this experiment is conducted intelligently it will be an unquestioned success, and its success will create a definite nation-wide demand for school films.

In many cities today schools employ competent union projectionists for their occasional film showings. When the use of school films is general, projectionists will have a new and tremendous field of full-time activity.

There is a definite trend toward the use of standard 35 mm. film in the schools. This implies the use of projectors of the semi-portable or fixed type. Competent operation will be necessary and projectionists may well look forward to this new era.

Boone Mancall

SIXTH YEAR of PUBLICATION

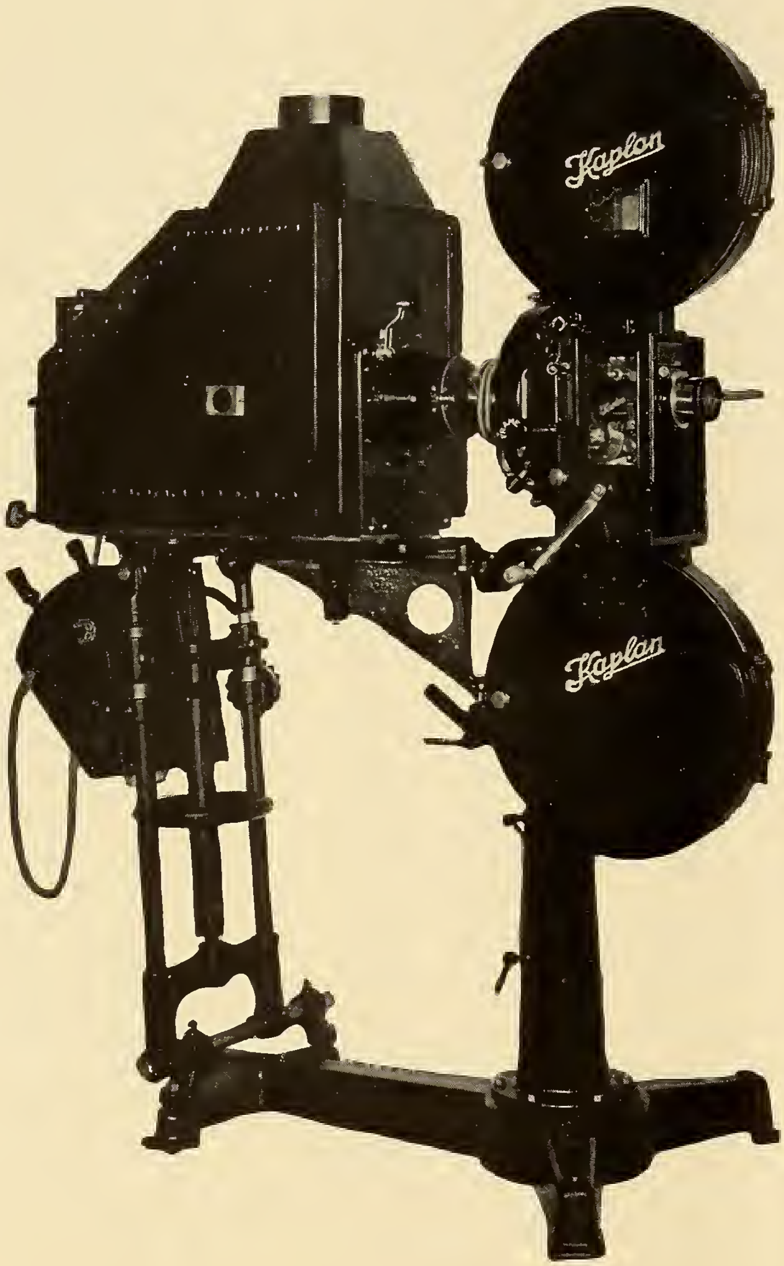
Published by the MANCALL PUBLISHING CORP., Boone Mancall, President.
Editorial and Advertising Offices, 7 West 44th Street, New York City
Entered at New York Post Office as second class matter, October 25, 1927.

Vol. 5 No. 12
OCTOBER, 1932
25c. per copy :-: $2.00 per year

THEATRE NOISE PROBLEMS AND THEIR SOLUTION
IN THIS ISSUE

Kaplan

PROJECTORS



Widely used in this country—known internationally, the Kaplan Projector is universally recognized as a product of the first rank. It has earned its reputation because it is designed and built on the best engineering principles.

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.

729 SEVENTH AVENUE
NEW YORK CITY

Western Electric . . . a proven patronage builder year after year

6 years . . . and 6 mighty steps ahead!!!

1926

First commercial sound picture: recorded and reproduced by Western Electric.

1927

First all-talking picture: recorded and reproduced by Western Electric.

1928

Leading producers contract to record by Western Electric exclusively.

1929

ERPI's nation-wide service staff reduces program interruptions to 1-10 of 1%.

1930

New equipment makes Western Electric quality available to smallest theatres.

1931

Western Electric Noiseless Recording does away with all ground and surface noises.

1932

Western Electric Wide Range Sound brings talkies even closer to perfection.

SINCE 1926, Western Electric has maintained leadership by holding to the *highest possible standards of quality for recording and reproduction.* Outstanding results in 8836 Western Electric equipped theatres — including 2405 replacements of other equipments — prove the soundness of that policy!

ERPI's nation-wide staff of engineers — rendering a systematic trouble-prevention service — has protected exhibitors against costly breakdowns, assured maintenance of quality sound and made possible constant improvements over the six-year period.

Now — more than ever — Western Electric equipment is a *sound capital investment.* It affords financial stability, patent protection, assurance of highest quality of sound and continued development. Discriminating audiences will go to the theatre where Western Electric standards are maintained.

Get your house in order now!

Western Electric
THE VOICE OF ACTION
SOUND SYSTEM

Northern Electric in Canada
Distributed by
Electrical Research Products Inc.
250 West 57th Street, New York

Defective Equipment Is A Serious Handicap To The Projectionist And Constitutes A Grave Fire Hazard

Upon Request
We Will Be Pleased
To Send New Booklet
Giving Full Particulars
Regarding The New
Simplex-Acme
SOUND PROJECTOR

INTERNATIONAL PROJECTOR CORPORATION
90 GOLD STREET
NEW YORK, N. Y.

MOTION PICTURE PROJECTIONIST

October, 1932 Vol. 5, No. 12

EDITORIAL BOARD

CECIL FOWLER, *General Supervisor;* LESTER ISAAC, *Efficiency;* J. H. KURLANDER, *Light;* J. E. ROBIN, *Equipment;* W. W. JONES, *Theory;* HARRY RUBIN, *Improvement;* VICTOR WELMAN, *Personnel;* SIDNEY BURTON, *Production.*

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. ....Entered as second class matter October 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road,
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth Street
Melbourne, Australia.

Editorial & Advertising Offices
7 West 44th Street
New York City

National Advertising Manager
Boone Mancall

OUR PLATFORM

To maintain always the integrity of the original policy of this publication: that it be a means of raising the standards of projection by a ceaseless campaign of education among the many thousands of projectionists in the United States and Canada.

That every available inch of space in each issue be devoted to this end.

That we be interested in neither the politics or the personalities involved in the politics of the International Alliance of Theatrical Stage Employees and Moving Picture Operators or of any other group or body of projectionists, because such interference with internal affairs of labor organizations will make this a partisan and political paper and destroy its value to the craft which lies in educational work only.

That by maintaining our policy of education we will enjoy the support of projectionists everywhere for many years to come as we have enjoyed this support for the last five years as the leading projection publication in the country.

The Editors and Advisory Editors and the organizations with which they are affiliated do not necessarily endorse all the statements or opinions offered in this magazine. The author who signs an article assumes full responsibility for the statements it contains.

EVERY PROJECTIONIST NEEDS A SUPPLY . . .

A little cement . . . an Eastman patch . . . a minute's time, and the sound film splice has been blocked out . . . cleanly, accurately . . . without fuss or bother . . . and in a way that obscures a minimum of the sound track. Every projectionist should have a supply of these ingenious patches, together with the precise registration block designed especially for them. Prices: Eastman Sound Film Patches, per thousand, $5.00; Eastman Sound Film Patcher (registration block), $4.25. Eastman Kodak Company, (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood).

EASTMAN SUPER-SENSITIVE
PANCHROMATIC NEGATIVE (Gray-Backed)

Universal Film Splicing Machine

MODEL NO. 3 Pat. March 22:22

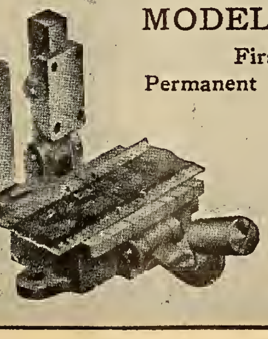
First-Class Results on New or Old Film

Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

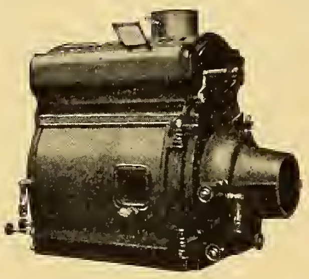
GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers

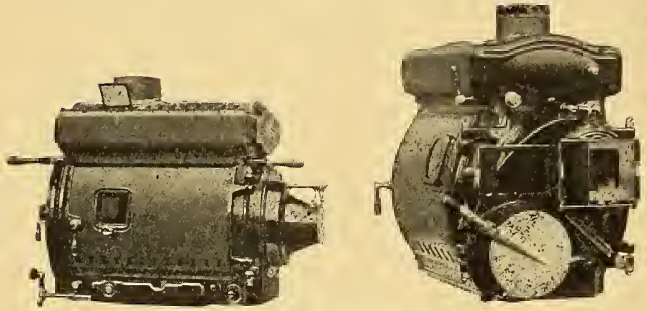


Brenkert

Projection Lamps

in theatres from coast to coast are daily producing highest quality projection at low operating cost.





Super High Intensity — Hilow — Standard Intensity

A size and type to meet any projection requirement. Sold and serviced by independent supply dealers.

WRITE FOR LITERATURE

A Brenkert PRODUCT

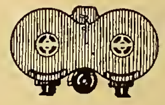
CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

. . Your EQUIPMENT NEEDS ARE PROVIDED FOR AT NATIONAL!

Supplies - - accessories - - repair parts - - new equipment. Your National store is THE satisfactory source of things you need that contribute to greater satisfaction in the Projection Room. We don't wait until you must have a part, to order it for you. It's waiting for you - - at National - - when you need it.

Power Rewinds



Latest approved, silent-operating, safe-acting apparatus for rewinding and all handling of sound films.

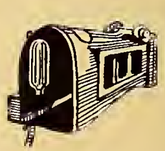
Sound Reels

Smooth-running, accurately machined reels for sound film. A variety of types to choose from.

Film Cabinets

Sturdy built, easy-to-open-and-close, safety cabinets of latest type and lowest prices.

Light Shields



All modern devices for aperature heat reduction, accurate framing and positive eye protection.

Inquire about our FREE Equipment Inspection Service. Early attention may prevent a serious break-down.

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

AS I SEE IT

ℭ Pay Cuts Again

THE editorial entitled "Pay Cuts" which appeared in the previous issue of the MOTION PICTURE PROJECTIONIST has brought to our office an assortment of letters from various parts of the country and one of them from Canada. All of them are in the same tone. Cut after cut has placed many of their writers in desperate straits and few of them have had time to adjust themselves to the new situation. I know that a thousand letters would carry the same tune. While these men are in a predicament common today I do hope that it will not be long before living standards rise and peace and contentment reign again.

ℭ One Man's Way

While on the subject of pay cuts it is instructive to review the conduct of one man in the motion picture industry who is at the head of a nation-wide company with great responsibilities. I am not at liberty to give his name as I learned the facts in an informal and intimate interview but his actions and his attitude sings through these desperate times. To those of us whose eyes are sometimes clouded with hopelessness this man's far-sightedness and considerateness is a pledge to the future, the future that will surely see an end to ignorance and wilful blindness in the relationships between men.

His company employs hundreds of men and many women in clerical positions. It has not been exempt from the times and its business has fallen off, though not at an alarming rate. It has fallen off enough however to necessitate severe retrenchment all along the line. Salaries had to be reduced and the operating overhead of the company has been sharply cut to square with present-day economic facts. But it has not been done high-handedly and arbitrarily and today his organization functions just as smoothly as heretofore and best of all his far-flung employees are just as loyal to him and to the company as ever before.

The whole burden was not placed on the employees though drastic reductions in salaries alone might have solved his problem. Leases everywhere were altered to reduced rentals, saving the company many thousands of dollars. Economies were effected at once in inventories and in sales work, without however impairing the efficiency of his various units. But best of all he started with himself.

I do not know what this man's salary is and I do not care. I should judge however, viewing the responsibility of his posiiton that it must have been considerable. He cut that down almost by half!

What an example to set before high-salaried executives in this business, many of whom draw many times this man's former salary. I say many times because it is no secret that a salary of a motion picture executive as low as $50,000 a year is considered rather paltry. Salaries of $100,000 and more a year are, even today, in these straitened times, common facts.

It is true that these executives have not been immune from salary reductions. But it must not be forgotten that while severe cuts were meted out to employees whose salaries were never higher than $4,000 a year, the high-salaried executives merely took their cuts in the same proportion. A 20% cut to a man getting, say, $52,000 a year means that he is still getting $800 a week and he isn't exactly starving. To a projectionist getting $60 a week or to a clerk getting $35 the cut means the difference between simple food, shelter and clothing and the lack of these essentials to a sane life.

But to get back to this man.

In cutting his employees' salaries he did several significant things. In the first place he saw to it that each one of them had a basic salary to admit of an existence without worry. He posted notices of coming reductions weeks in advance asking his employees to take immediate steps to adjust their mode of living to the newer scale. That was eminently considerate and revealed a sympathetic understanding of human rights and human needs.

But he did something else, very significant too. On the assumption that he had no arbitrary right to exact more from his employees than he was giving them in return he put them on a five-day week. That is they worked less because they got less.

And miracles of miracles: he advised them that if he found it necessary to keep them at their desks on the sixth day he would restore their full pay for the week.

Contrast this action with the action of theatre owners—particularly the large chains. Not only have projectionists taken cut after cut but there has been a ceaseless attempt to cut down the number of men in the projection crew and, to top that, to have them work longer hours.

Our talk was never intended for publication and I am taking liberties in putting it down on paper. But this man told me that his actions brought forth sharp criticism even from the executives in his own organization. The concensus was that the employees would take their cuts and take them cheerfully too. And furthermore they could work that sixth day whether they liked it or no and without getting paid for it. His policies, though, continue to guide the organization.

And there you are. I have not told the half of it. But if there were more such forward and understanding men in the motion picture business it would be more efficient by far.

B. M.

How to Select A Proper Screen

By FRANCIS M. FALGE

THE proper presentation of motion pictures depends upon the perfection of many details, any one of which may result in poor picture quality if not perfect. An efficient projectionist provided with technically good film in satisfactory condition, a good light source and projector, may produce all of the essentials for the mechanics of the picture presentation, but none of these details are visible or even of passing interest to the patrons. Not until light falls on a screen are the latter conscious of a picture and it may faithfully interpret the subjects or distort them beyond measure.

This article was prepared especially for the MOTION PICTURE PROJECTIONIST and is complete in this issue.

Large sums of money are spent in the making of films and on the projecting of them until the screen is reached. Here a serious condition exists, for not only are improper and inefficient screens installed, but they are allowed to become so dirty picture quality is seriously harmed.

This is largely a result of lack of responsibility and consequently of interest on the part of theatre employees. The responsibility of the projectionist usually ceases at the booth wall, and there is no one else to determine the merits of a screen. To remedy this, the maintenance of the screen must be the projectionist's responsibility as is the rest of the projection equipment of which it is part.

Much money is spent on lenses, reflectors, carbons and what not in an effort to increase the picture brightness even as little as 5%. Yet the screen in the majority of houses is losing 50% of the light projected on it because the right screen is not used, or because it is not regularly cleaned.

The screen is not in the booth, but it is distinctly the projectionist's problem. He should give it as much care and attention as he does his light equipment. It should have the same tests and reports; the same care and consideration. In this manner only can a check be kept of the performance of the screen, and of its loss to the theatre. It will also save the projectionist from criticism because of dull pictures or the increased current consumption necessary to keep the picture stisfactory. Our eyes are a poor means of judging the condition of a projection surface unless it is to view streaks and other obvious imperfections. Only by the use of light meters can illumination be evaluated accurately. By checking with a known sample having the proper initial reflection value this may be estimated sufficiently well to indicate the screen's performance.

The proper amount of light for a picture is still an unanswered question although the Projection Screens Committee of the S. M. P. E. is now taking steps to determine this. Light is measured in foot candles and brightness in millilamberts. A well-lighted office desk, for instance, has an illumination of about ten foot candles, whereas the light globes furnishing the light may be many times brighter. A low intensity installation with a 13-6 x 18 screen may provide about six foot candles at the screen, and the light returned to the eyes might be as much as 85% of this if the screen were new, or less than 50% if it were old.

The brightness of the screen as seen by the viewer would depend entirely on the distribution of the light reflection, whether it were spread evenly in all directions or by "reflecting means" distributed in certain desired directions. Screens act the same as reflectors. A bare lamp, for instance, sends light out evenly in all directions. If a bowl-shaped reflector surrounds it, the light is directed in one direction as from a screen, and if a designed reflector, such as is used for automobile lamps is used, the light is directed to the points where it is most needed. Theoretically, the greatest economy would result by the use of a screen "tailored" for each theatre. However, such a scheme is impractical as the screen would be very costly. Fortunately, the general use of screens designed on several principals of redirection of light allows satisfactory results for certain groups of houses, so that the selection of the right type of screen is all that is necessary.

Reaching a False Decision

In general, it is not correct for a person who has not made a serious study of screens to decide by viewing in another theatre whether the same screen would produce satisfactory results in his. The length and width of the house, projection angle, type of light source, lenses, shutters, etc., vary so widely that all of these things must be considered before a choice can be made. Also the lighting of the house, the light spilled on the screen, and the screen surroundings all vary greatly. However, a person well versed in the characteristics of screens can, after a study of the conditions of a particular house, generally suggest the best type of screen. The exhibitor and projectionist, however, should have this proven by having a large sample spread side by side over the existing screen a new sample of each screen so that their relative efficiency may be shown. It is not satisfactory to judge by having the new screen lowered over the present one, as our eyes are likely to deceive us in a matter such as this. When the above mentioned test is made, the picture should be viewed from every part of the house and an analysis made with an estimate of the seats benefited.

Under a white booth light the test is difficult, for all characteristics are not evaluated. It is preferable to use a film in the projector so that the highlights and shadows and quality of the pictures may be compared. So many factors enter into the proper choice of a screen that only by the greatest care and consideration can the choice be made. It is therefore necessary to give full value to each of the points in the discussion which follows.

A Projectionist's Problem

Projectionists can render a very valuable service to their employers by making a thorough study of screens so that they can give expert advice just as they do on lamps or projectors. They can save the theatres considerable sums of money by familiarizing themselves with the following details and intelligently applying them and thus make themselves more valuable.

Principles of Light

Without light there would be no sense of sight. Nothing could be seen. On the manner in which light is used depends the view which is produced in the eye and transmitted to the brain. Whether it is a flat and lifeless picture without body, depth or detail, or a clear rendering of exquisite beauty depends on the nature of the light and shadows, their contrast and color their brilliancy and their compostion. The lighting of the surroundings also has much to do with the picture that is transmitted to the eye. Spilled light destroys contrasts and tends to cloud and destroy the picture. It is important then to remember these things in a discussion of screens which are entirely a matter of sight, and to remember too, that it is not the light that is given off from the lamps or through the lenses which goes to the eyes of the patrons nor even the light which falls on the screen, but that which is transmitted to the eye as a picture built up of lights and shadows.

Units of Measurement

In lighting there are several units of measurements which one should understand in order to make a complete analysis of a projection problem. They will be explained briefly: First, there are two units which pertain to the source of light itself, in this case a projection lamp or carbon arc.

Candle-Power

The most familiar unit is candle-power. The candle power is a unit of intensity of a source in any given direction, as compared with the light from a standard candle. It gives no indication of the amount of that light. For instance, a twenty-one candle-power automobile lamp when the light is redirected by a reflector may give 100,000 candlepower in the brightst part of the beam. Carbon arc sources are usually rated in candle power per square inch, because it is the intensity of light in a certain place and a given direction that provides the necessary projection source to be redirected by lenses or reflectors.

Lumens

The lumen is a unit of quantity of light and is the quantity of light intercepted from a one-candle-power source by a surface of 1 sq. foot on a sphere with a radius of 1 foot. A 50-watt Mazda lamp may give 400 lumens of light. The above units are measured by a photometer.

Foot Candles

The effect of light is determined by a unit called a foot candle. A foot candle is the level of illumination at a point on a plane one foot distant from the source of light of one candle. It is measured by a foot candle meter.

As an example, a well-lighted office has a level of illumination of about 10 foot candles. The light from the sun may be in the neighborhood of 6,000 foot candles. To reflect on the manner in which our eyes adapt themselves to each of these intensities will show their great usefulness and also tell us that it must be other things than just quantity of light which causes eye-strain.

Millilamberts of Brightness

One other unit of great importance is the millilambert. It is the unit of brightness. This unit determines the brilliance of the light coming from the screen. This unit is of great importance in analyzing glare as it is the brightnes contrast that produces glare. For instance, under a sky producing 6,000 foot candles, we are not conscious of glare, but if we should be looking toward a window in a fairly dark room, then there would be an intense glare. This same fact is true of screens and their surroundings.

Inverse Square Law

A further important fact concerning illumination is the relation between foot candles, candlepower and distance. The quantity of light in foot candles varies inversely as the square of the distance. If, for instance, a point is selected one foot from a one candlepower source, there is one foot candle of illumination. If this were a two candlepower source, there would be logically two footcandles. If, however, a point two feet from a one candle power source is taken, the same beam of light must now cover four times the area as before, and therefore the illumination is one-fourth of that in the first case. This is known as "the inverse square law."

This fact is essential in the proper understanting of screens and directly concerns the size of screens and the brightness of them. If, for instance, you are operating with just sufficient light on a 12 x 16 foot screen having 192 square feet, it would be very imprudent to change to a 15 x 20 screen having 300 square feet, as this would cause a reduction in brightness of about 31 1/3 per cent.

Light Distribution

Light may be given off equally in all directions, or by the use of reflecting surfaces, the light may be redirected so that the distribution is entirely changed. In screens, this is important. The object of course, of a screen is to provide each seat in the house with exactly the same picture. This is not practical, but is possible to a certain extent. Two light considerations must, therefore, be made in deciding on a screen, the other factors being the same, namely the total amount of light that the surface can reflect, or the reflection value of the surface, and the distribution of the light so as to benefit the majority of the seats.

Principles of the Control of Light

The efficient use of light depends on the method in which it is distributed and utilized. Light may be used either by transmission or reflection. Absorption results in a direct loss of light. Transparent materials transmit most of the light striking them without spreading it. Objects can be seen clearly through a transparent material. Translucent substances transmit light, but scatter or diffuse it so that objects are not clearly visible through them. Opaque substances do not transmit any light waves but either absorb or reflect them.

> Mr. Falge, at present associated with ational Electric Light Works in Cleveland is rated among the highest authorities in his knowledge of screens and their properties. He has written extensively on the subject and has often contributed to the pages of the MOTION PICTURE PROJECTIONIST.
>
> In future issues Mr. Falge will be asked to continue his exposition of screens in the light of new developments.

Light may be absorbed, thus being lost.

Light may be refracted or bent in passing through a transparent material.

Light may be reflected or redirected.

Light may be diffused or spread in all directions.

Upon these four methods, absorption refraction, reflection and diffusion depends the control of light.

The screen should absorb as little as possible of the light, as this is an added loss. In other words it should have as high a reflection value as possible.

The quality of the picture is dependent on a number of considerations. Perhaps the most important is the sharpness of the reflected image. This should be clean cut and distinct as any diffusion of this image that may be deemed desirable should be done at the studio by known photographic methods.

A further important consideration is the contrast between the highlights and shadows. Here again the maximum contrast, while still retaining the proper brightness of the highlights, is best because the shadows become less black with intensity. There is a compromise point at which the picture will appear best. In this connection it is important that as much as possible spilled light by house lights be eliminated from the screen as it destroys the contrast of the shadows and consequently the quality of the picture.

The other important consideration is color. At times a trend to the yellow or blue has been advocated. White is a comparative term, that is dependent upon association. A low intensity of light generally causes yellowing of the picture just as does dirt collection. For this reason, a yellow tone does not seem justified. Psychologically a blue quality is desirable, however it does not seem practical to tint the screen blue other than to match the quality of the light source as it results in a loss in efficiency and consequently of light that is not made up by the supposed improvements in quality.

Historical Resume

Motion pictures have of course antedated sound pictures by many years, and they have left behind an interesting trail of development. In their infancy a piece of white sheeting or a painted wall served as the surface for pictures. In the natural scheme of things, metallic reflecting surfaces, mirrored glass and built up surfaces were developed to provide an improved surface and a more economical one. This also resulted in improvements in the white diffusing surfaces to inrease their efficiency.

The advent of sound pictures in 1927 caused a radical change in the surfaces. As in most other new phases of pictures, a tolerance of existing methods was disrupted and a change of methods forced. One of these was the sound screen. At first, there was a loosely-woven cotton material with a high percentage of open space for the sound (from horns placed behind the screen) to pass through. The cotton fibres were of low efficiency and the loss of light through the openings caused a very bad effect on the pictures.

The perforated screen followed with a greatly decreased amount of open space and a more efficient background of a coated fabric. One by one other projection surfaces followed suit and each was improved to a point that even previous silent screens had not achieved.

Sound and the Screen

In general it may be said that it is not the purpose of sound screens to improve or aid sound, but that they should allow sound to pass through with no objectionable effect on quality or volume. At first as much as 40 per cent of open space was demanded for sound purposes with a very serious harm to the picture. Experience has shown, however, that a much smaller percentage of open space is required, as little as 4 per cent.

It is possible for the screen to act as a diaphram to recirculate the sound from the horns, but it has been found that a great loss of volume and considerable distortion results so that the

(*Continued on page* 33)

Basic Design of New Simplex-Acme

By HERBERT GRIFFIN*

THE basic idea in the design and manufacture of Simplex-Acme was to secure compactness and at the same time retain all the notable qualities of Simplex professional projectors. The film operating parts are shown in the illustration accompanying this article which also shows the film in place for operation, the feed sprocket, the intermittent sproket, the sound gate feed sprocket, the constant speed sprocket and the take-up or hold-back sprocket. Tension shoes are shown for the sound tension roller, the constant speed sprocket and also for maintaining the film on the intermittent sprocket.

All pad roller and tension shoe arms are self-locking in the open or closed positions and cannot be opened by bad patches or other accidents. Due to the positive stops provided, which maintain the rollers in the same fixed position at all times, there is no danger of the distance between roller and sproket decreasing and tending to damage the film. The motion picture projection gate may be opened or closed by turning a knob to the right or left and in either position the gate is securely locked and cannot be accidently opened.

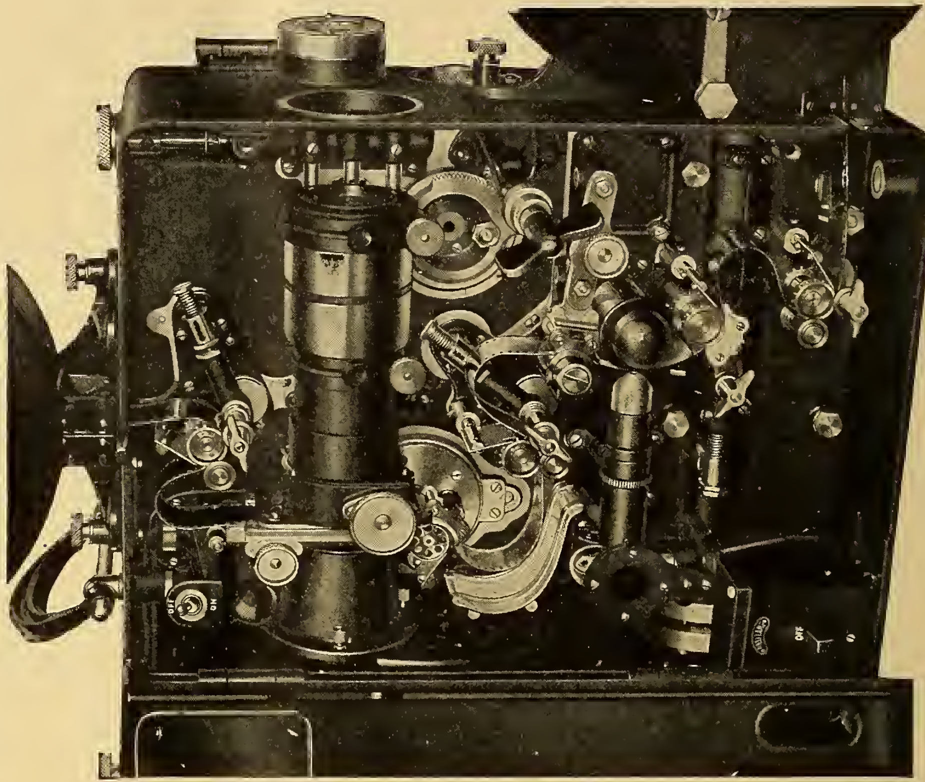
Every part of the film in the gate is supported from the intermittent sproket to a point above the aperture and the film trap is supplied with lateral guides which prevent side motion or sway. The film trap is an integral part of the lens mount and this secures proper alignment of these two units under all conditions. A tension spring attached to the lens mount guide rods prevents the lens creeping out of adjustment and also avoids the possibility of the picture getting out of focus.

A double aperture of the vertical sliding type is provided and by turning a knob either the silent film projection aperture or the sound film projection aperture is brought into place and locked in position. A pilot light gives illumination for properly placing the picture in frame when threading.

Stripper plates are provided for all sprockets and these prevent the film winding around the sprocket in the event of the parting of a poorly made patch.

A framing handle controls the rotation of the intermittent sprocket for framing the projected picture either before or during operation, and the knob projecting from the front of the take-up magazine will be found very convenient to turn over the mechanism and facilitate threading in frame.

The operating mechanism is entirely enclosed in the non-operating side of the projector—the opening of two doors exposes to view the mechanical operating parts of the equipment. It will be noted that the equipment is directly connected to the motor and no belts of any kind are used.



Mechanism of Simplex-Acme

As Simplex-Acme is entirely gear driven, eliminating all belts and chains, the possibility of slippage is avoided and assists in maintaining a constant speed. While the use of belts and chains may be unavaidable under certain conditions, it is obvious that they are not always absolutely reliable in the transmission of power, are subject to considerablle strain and wear, which entails repair and replacement, and are never quite so satisfactory as the gear driven mechanism. The complete elimination of belts and chains in the Simple-Acme is an additional evidence of simplicity and assurance of dependability.

A mehcanical filter is placed between the motor and the mechanism so that vibrations or other impulses from the motor cannot be transmitted to the mechanism proper. The driving shaft then continues straight through the lower part of the projector and is gear-connected to the constant speed sprocket shaft, the vertical driving shaft—which drives the balance of the projector—and take-up magazine.

The Simplex-Acme is driven by a motor built into the equipment and made to our own specifications. We believe it is the only motor that has a hardened and ground shaft and that it will wear three to five times as long as the ordinary motor with a soft. shaft. The flexible coupling on the driving side of the motor takes up the sudden shock of starting, which serves to iron out the impulses from the line frequencies. In effect it is a mechanical filter to give a more even flow of power.

Intermittent Movement

The intermittent movement and shutter synchronizing device are mounted in one common carriage and this system is fundamentally new in design. The improved design enables us to harden and grind both star and cam and is similar to that in our latest standard professional projector used in deluxe theatres throughout the world. There is but one pair of gears between the came shaft and shutter shaft and this notable feature eliminates back lash which in turn avoids travel ghost in the picture. As the intermittent sprocket rotates on its own center, the distance between the sprocket and the aperture remains fixed at all times, regardless of the changing position of the framing device. Therefore, only enough pressure on the film is required to hold it against the runners on the film trap and thus "over-shooting" is prevented. A light but steady pressure exerted on the film in the gate and at the intermittent and sound sprockets prevents damage to the sprocket holes and greatly extends the life of the film. It is obvious that a heavy pressure greatly increases strain on the intermittent sprocket and it is equally evident that a light steady pressure, lessens the strain which, of course, decreases wear and increases steadiness.

(Continued on page 32)

---

* General Sales Manager, International Projector Corp.

Sound Systems in Rockefeller Center

By JAMES FRANK, JR.

THE city in a city now rapidly nearing completion in New York City and to be known as "Rockefeller Center," is to include two theatres, the larger to be known as the "International Music Hall," with a seating capacity of 6,300 seats, the smaller to be called the "RKO Photoplay Theatre," and having a seating capacity of 3,000 seats.

These two theatres are being equipped by the RCA Victor Co., Inc., with sound systems embodying the highest standard of electrical and mechanical design. The equipment was selected after a careful study of the plans and specifications of these theatres. The operating and control features have been designed to facilitate ease of control and provision has been made for selection of alternative circuits and amplifiers.

The equipment consists of standard RCA Victor sound reproducing apparatus especially assembled for this installation and of somewhat greater power than is customary to furnish for theatres.

The installation for the "International Music Hall" is the larger and covers a wider scope. It has a total undistorted output of 510 watts.

The RCA Victor Sound Systems to be installed in the larger theatre are divided into eight units, as follows:

1. Sound Reinforcing System.
2. Rehearsal Address System.
3. Stage Manager's Call System.
4. Main Sound Projection System.
5. Rear Stage Sound Projection System.
6. Deaf Headphone System.
7. Preview Sound Projecting Systems.
8. Radio and Monitoring System.

The installation of these systems is to be so arranged that through physical location and electrical connection certain of the equipments may be interconnected. Figure 1 shows the equipment layout on the projection room level. From the diagram the various amplifiers and sound reproducers may be easily located. Further reference will be made to this diagram under the description of the different systems.

It is important to note that the amplifiers, all of which employ standard Radiotrons, and loudspeakers used on the various systems are essentially alike although various assemblies of apparatus are employed.

1. Sound Reinforcing System

The purpose of this system is to reinforce the stage presentations and orchestra music to suitable levels in order that the desired aesthetic effects and clear intelligibility may be obtained at all points in the auditorium. This system consists essentially of a number of microphones, amplifier equipment, and loudspeakers, together with necessary control apparatus. The microphone transmitters located around the stage and orchestra pit pick up the voices or music, change the sound waves to electrical waves, which are fed into the microphone amplifiers. After the level has been raised by these units the electrical waves are fed into the mixers in the control console where they are properly mixed and then fed into a "booster amplifier." At this point the level is sufficiently raised to feed into the main amplifiers. From the main amplifier the electrical waves, now at any desired level, are fed into the auditorium loudspeakers where they are converted into sound waves again which are directed to all points in the auditorium. Intricate control apparatus is employed to properly operate this system.

Velocity Microphones

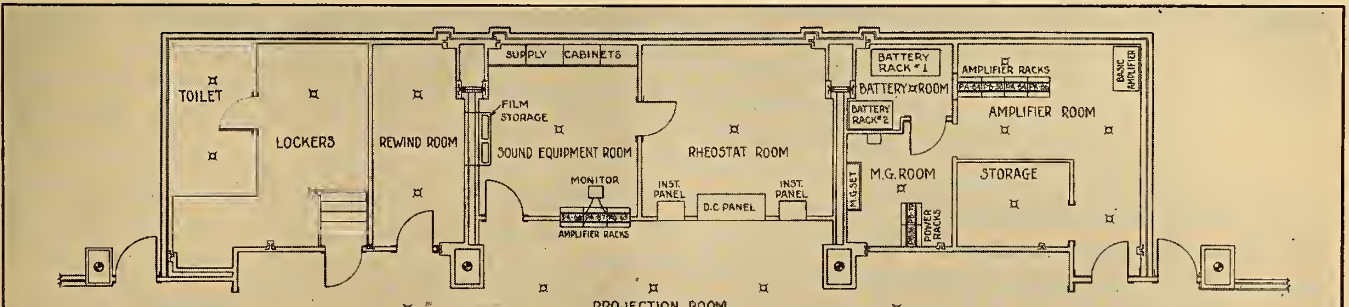
A. Fifty type PB-31 Velocity Microphones of the type used for sound recording are being furnished, mounted on swivel bases in order that they may be "aimed" in any desired direction. These microphones will be located as follows:

8 Microphones in traps in the floor of the orchestra elevator.
8 Microphones on program stands on band wagon.
8 Microphones suspended from light bridges.
11 Microphones in foot lights approximately on seven foot centers.
9 Microphones on stage connected to traps on the stage floor.
6 Microphones (3 on each side) on choral stairs.

The Velocity Microphone contains a thin metallic ribbon suspended between the poles of a permanent magnet in place of a "diaphragm." Sound waves reaching the ribbon vibrate it within the magnetic field set up by the magnet.

The Velocity Microphone has many advantages over any other type available. The sensitivity of the Velocity Microphone is approximately 2½ times that of a Condenser Microphone generally used. This makes possible an increased operating range. The microphone responds very faithfully to all sound vibrations over the range of audible frequencies from 30 to above 10,000 cycles. This is due principally to the smallness, the size and mass of the ribbon element placed in the free space. The faithfulness of response of this microphone imparts a naturalness of tone and a distinctness of speech not hitherto attainable with other units.

The most important characteristic of the Velocity Microphone is its directional property. Since the ribbon is suspended in free space, sound waves approaching the microphone from a direction on the same plane as the ribbon have no effect upon it but sound waves from either direction along an axis perpendicular to the plane of the ribbon have a maximum effect. For equal distance from the transmitter, sound originating 70° or 80° of the axis perpendicular to the ribbon will have practically no effect whereas at 45° off of this perpendicular the sensitivity is approximately 70% of the maximum. This characteristic is of great value in the solution



Layout of Projection Room in Rockefeller Center Theatres of some of the difficulties usually encountered in reverberant locations by the reduction of the effect of undesired sound selectivity in sound pickup. In addition, this characteristic is likewise outstanding in that this is the only type of microphone that responds uniformly to all audible frequencies over the entire 45° angle. This permits placing microphones in the footlights on approximately seven foot centers with the result that uniform pickup of all frequencies is accomplished across the front of the stage.

Another great advantage of the Velocity Microphone is its uniform operation independent of changes in climatic conditions such as atmospheric pressure, humidity, or temperature, any or all of which considerably affect other types of microphones.

The Velocity Microphones are designed for either suspension, program stand or footlight mounting.

B. Fifty type PA-32 Microphone Amplifier will be furnished. These amplifiers will be located on a specially constructed rack located in an amplifier room in the basement under the stage. The amplifier is carefully shielded to render it free from external interference and undesired pickup. The entire unit is enclosed in a cylindrical metal case particularly designed for wood rack mounting, and is mounted vertically with connections made through plugs at the top and bottom. Power supply to operate the unit is made available from the amplifier room on the projection room level.

Control Console

C. A type PS-78 Control Console is to be furnished for controlling the individual microphone amplifier outputs and mixing them properly for amplification. It is located in the control room, as shown in Figure 1. The console is of the mahogany desk type with metal top on which all the controls are located.

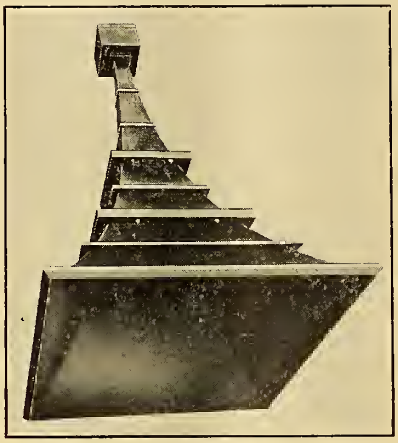
At the front right side of the control console is located an 80-jack panel at which point the outputs from the fifty microphone amplifiers terminate. The additional jacks not accounted for are for expansion. Directly in front of the jack panel are 38 cords and single plugs with weights and rollers divided into four groups, two of eleven each and two of eight each, each group with a distinctive color. The cords are arranged in four rows.

At the back right and left side of the control console are located four mixers—two eleven-position mixers and two eight-position mixers—each with its distinctive color on the mixer knob and wired to its respective cords mentioned above. On the console top a four-position mixer is located, one position for each of the above mentioned mixers, which controls the level of its respective group. By plugging the plugs into the jacks any combination of microphones, with a maximum of thirty-eight, in groups of eight or eleven may be selected and mixed in the four mixers. After this position the output of each of these four mixers is fed into the four-position mixer. A master mixer is located on the console top which controls the mixed output of the four-position mixer.

At the front left side of the console top a "booster amplifier" is located which compensates for the loss in the control console. The output from the master mixer is fed into this amplifier and the level is raised to such an extent that the output can be coupled to the main amplifier.

A Volume Indicator is mounted on the console top at the rear in a vertical position. An adjustment is supplied so that a predetermined reading on the meter may be made to represent any output level of the amplifier.

At the front left side of the console is located a jack panel for changing normal connections of the outputs of the eight position and the eleven position mixers into the four position mixers to prevent the failure of one unit of the four position mixer from interfering with the operation of the system. In case of emergency, it is also possible to circumvent the four position mixer and (or) the "booster amplifier" to feed directly into the main amplifier at a reduced output.


Type PL-35 Loudspeaker

The separate control units of the mixers can be removed for repair at a moment's notice, such removal not affecting the operation of the remaining units.

Amplifiers

D. The main amplifier equipment consists of two duplicate eighty watt amplifier channels, Type PB-84. These amplifiers are primarily arranged for operating in duplicate; that is, one at a time, the other being held in reserve for emergency use. However, provision has been made so that one channel may be used on the regular sound reinforcing system and the second channel used at the same time to operate the effect loudspeakers. These amplifiers, consist of units mounted on standard channel-iron racks and are located in the amplifier room as shown on Figure 1.

Each of the channels includes necessary terminal strips, main power line switch, a Type PB-23 voltage amplifier unit, two Type PB-45 Power Amplifier Units (40 watts each), and a Type PB-24 Power Amplifier unit (10 watts).

All amplifier units are complete in themselves in that they contain their own A.C. operated power supply apparatus.

The 10 watt power amplifier unit is used for the Deaf Headphone System The output impedance is such that a variable number of headphones may be installed. All headphones are connected across the output of the amplifier in series with an adjustable resistor of sufficiently high value that all headsets may be removed from their jacks without affecting the frequency characteristics of the system.

Miscellaneous Equipment Rack

E. The Type PB-50 Miscellaneous Equipment Rack which is located with the main amplifier includes an audio relay panel, two jack panels, a Type PB-51 tube testing panel, a Type PB-55 radio receiver, a Type PB-75 phonograph turntable, a Type PB-50 amplifier unit.

The audio relay panel includes the relays required to switch the deaf hearing system amplifier to either the sound reinforcing system or the main sound projection system, to switch either of the sound reinforcing system amplifier channels into the circuit and to connect the stage manager's call system to the sound reinforcing system when desired.

The two jack panels are used for "patching" or interconnecting. The input and output circuits of all amplifiers on the sound reinforcing system, rehearsal address system and stage manager's call system are brought out to these panels as well as the outputs of all special apparatus including radio receiver, phonograph turntable and the like. For normal operation no cords are required but for special interconnections or for use of special apparatus cords tying the desired circuits are used in these jack panels.

The Tube Testing Panel is designed to test all tubes and tube circuits employed in the amplifier and power racks.

The Radio Receiver is a nine tube superheterodyne radio receiver, providing excellent performance in all the features incorporated in modern radio broadcast receivers. Automatic volume control, push-pull pentode output stage, tone control, calibrated kilocycle dial and the inherent sensitivity, selectivity and tone quality of the superheterodyne circuit are some of the features of this receiver. This unit will work in conjunction with any of the power amplifier units in the system.

The Phonograph Turntable consists of a single turntable designed to operate at 78 revolutions per minute. A volume control is mounted on the base board adjoining the table. The whole unit is mounted on a panel which is hinged to the rack so that when it is not in use it is in a vertical position with the panel screwed to the rack channel. When in use it is lowered from the top and held rigid in front of the rack.

The amplifier unit included in this rack is used for monitoring purposes. This unit may be connected across the output of the power amplifier unit of either the sound reinforcing system, effect system (one channel of sound reinforcing system), stage manager's call system or the rehearsal address system and will operate the monitor loudspeakers on the Type PB-60 power control rack, in the amplifier room, in the spot cove, or at the chief electricians' position.

Power Control Rack

F. The Type PB-60 Power Control Rack is located adjacent to the control console in the control room, as shown in Figure 1. This rack includes a microphone power control panel, an amplifier power control panel a rehearsal microphone mixer an audio control panel a monitoring loudspeaker panel and a chief electrician's microphone control panel.

The microphone power control panel includes switches which through the use of relays turn on the power to all microphone transmitters and microphone amplifiers.

The amplifier power control panel includes switches which through the use of relays turn on the power to all the amplifiers used in the sound reinforcing system and rehearsal address system.

The rehearsal microphone mixer includes mixer units for controlling the output of each of the four microphones used on the system with a master mixer to control the group.

The Audio Control Panel includes two key switches one to select, through the use of relays, amplifier channels for this system and the other to connect, through the use of relays, the deaf hearing amplifier to either the sound reinforcing system or the main sound projection system. In addition, four remote volume control push button stations are included, controlling the volume on each of the amplifier channels of the sound reinforcing system, and of the rehearsal address system.

The Monitoring Loudspeaker Panel includes a panel mounted electrodynamic loudspeaker unit with volume control.

The chief electricians' microphone control panel consists of a control unit to equalize the output of the carbon microphone used by the chief electrician on the rehearsal address system to the three velocity microphones used on the same system.

Power Supply Racks

G. The Type PB-76 Loudspeaker Control Rack is located also adjacent to the control console in the control room as shown in Figure 1. The rack includes two sound reinforcing loudspeaker control panels and two rehearsal loudspeaker control panels.

H. The Type PB-56 Power Supply rack which is located in the motor generator set room, as shown on Figure 1, includes an A.C. relay panel, two D.C. relay panels, and two plate and bias supply units.

The A.C. relay panel includes a number of relays to connect the A.C. supply to the rectifier tubes. The two D.C. relay panels include a number of relays to connect the power supply to the microphones of both the sound reinforcing system and the rehearsal address system.

The two plate and bias supply units are connected in duplicate, one being used regularly and the other as emergency, and are used to supply plate and bias power to the microphone amplifiers and the "booster amplifier." The unit is designed to operate from a 205-220 volt, three phase, 60 cycle A.C. supply. It is essentially a three phase—six phase rectifier. This type of unit by virtue of its fundamental principle of operation reduces the percentage of A.C. ripple voltage in the D.C. output voltage of the rectifier tubes. This is a distinct advantage over the common one and two phase rectifiers in that less filtering is required at 360 cycles to reduce the percentage of ripple voltage to any predetermined level than at 120 cycls. This reduction in required filtering improves the regulation of the rectifier in that the series resistance factor of filter inductances is reduced to a minimum. The regulation of the rectifier is further improved by the use of the mercury vapor (Radiotron UX-866) rectifier because the voltage drop in this tube is practically constant for any load within the tube rating. These factors are very important because of the fact that this rectifier supplies plate power to several microphone amplifiers.

J. The Type PB-79 Power Supply rack is located adjacent to the PB-36 power supply rack and includes an A.C. relay panel, two Type PK-15 loudspeaker field supply panels and two Type PK-20 loudspeaker field supply panels.

The A.C. Relay Panel includes a number of relays to connect the power to the amplifier of the sound reinforcing system, effect system and rehearsal address system.

The two Type PK-15 loudspeaker field supply panels are used to supply power to the loudspeaker fields of the radio and monitoring system. Each panel delivers 0.5 amperes at 100 volts.

The two Type PK-20 loudspeaker field supply panels are connected in duplilcate, one being used regularly and the other for emergency, and are used to supply power to the fields of the sound reinforcing system and rehearsal address system loudspeakers. Each panel delivers 4.0 amperes at 100 volts.

Battery Supply

K. The battery power supply equipment is all located in the battery room as shown in Figure 1. This equipment includes four sets of glass jar storage batteries together with charging equipment.

A duplicate set of storage battery cells with a capacity of 1040 ampere hours is furnished to supply filament current to all microphone amplifiers and field supply to all velocity microphone transmitters of the sound reinforcing system and rehearsal address system.

A duplicate set of storage batterv cells with a capacity of 186 ampere hours is furnished to supply excitation to all relays used with these systems.

The cells are all mounted in racks against the wall.

A battery charging motor-generator set, together with control panel, starter, and necessary switches and conduit boxes is also furnished. The sets of storage battery cells are so connected that one set of each type are in use when the duplicate sets are being charged.

Loudspeakers

L. Six loudspeakers are furnished for use on the sound reinforcing system in the auditorium, four Model 4 PL35A1 loudspeakers and two Model PL35B1 loudspeakers. These loudspeakers consist of a directional baffle of the exponential type coupled to a six-inch cone driver of rugged construction. This type of loudspeaker combines the advantage of a flat frequency characteristic with high efficiency, uniformity of response over the entire angle of distribution and high power handling capacity. Figure 2 shows a view of one of these loudspeakers.

The four Model 4 PL35A1 loudspeakers employing 60-inch directional baffles are to be mounted behind a grill above the proscenium arch.

The two Model 4 PL35B1 loudspeakers employing 37-inch directional baffles are to be mounted in the wall, one on each side of the proscenium arch.

M. For effect purposes two Type PL-64 loudspeakers employing 17 directional baffles will be furnished for mounting at the rear of the stage over the rear stage projection room. These speakers may be connected to the second amplifier channel of the sound reinforcing system for simultaneous or separate operation when back-stage sound effects are desired. Each directional baffle employs four of the six-inch cone units.

N. For monitoring purposes three Model AF6179 loudspeakers will be furnished, one to be located in the spot cove, one at the chief electrician's position, and one in the amplifier room. These loudspeakers consist of a standard magnetic speaker mechanism mounted in the rear of a specially designed wood plaque faced with three-ply veneer and the center of matched oriental walnut.

The over-all frequency characteristic of the sound reinforcing system is such as to give faithful uniform reproduction over the entire range of 50 to 10,0000 cycles.

Main Sound Projection System

This system consists of a duplicate channel eighty watt A.C. operated sound reproducing system employing four soundhead attachments. This equipment is similar in every detail to the "standard" series of RCA photophone sound reproducing equipment. The entire projection room equipment is finished in a specially selected green to match the balance of the projection room equipment.

A. Four Type PS-20 Simplex soundhead attachments are to be furnished with this system for mounting in the projection rom as shown in Figure 1. These attachments are to be mounted on Chicago cinema bases with super Simplex mechanisms. The attachment is the same as supplied with "standard" series RCA Photophone equipment except that three phase A.C. motors are employed.

(*Continued on page* 29)

I Consult My Projectionists

By DAN CUTLER

IT has been said frequently that the only time the projectionist makes contact with his theatre manager is around September—when a new wage scale is to be settled. That is not true, for like all statements made without qualification it is wholly one-sided. While the projectionist may not contact sufficiently it is also a fact that the theatre manager does not encourage it and often evades it. It is equally true that a much better understanding and closer co-operation between them would result in greater efficiency.

If my own case were taken as an example, I can point with pride to many years of active cooperation with my projectionists through a managerial career in a number of theatres in and around New York City. One of my first acts when taking over a new theatre is to make the acquaintance of my projection crew. I suggest and encourage their coming to me frequently with their difficulties in the projection room insofar as it concerns the equipment and consequently a good show at all times. I have made it a habit for years to make at least one weekly visit to the projection room to inquire as to the condition of the equipment and the need for replacements.

I do not remember having bought a single piece of equipment in my entire career without having consulted and received the recommendations of my projectionists. If they are not familiar with all the types of apparatus up for replacement I make them go to the nearest supply dealer to look the equipment over and if possible get a demonstration. Or go to neighboring theatres where other types are being used.

Often I ask my projectionists to do things not ordinarily requested in other theatres, but my purpose is to get them into the habit of coming to me, to breed a feeling of cooperation and to give them confidence and real interest in the welfare of their department. In this connection I insist on my projectionists giving me a report on the condition of the prints of each new film that comes to the theatre. When they give me the report they take the opportunity of discussing other matters that pertain to their work. In the matter of film reports I am happy to say that it once saved my theatre several hundreds of dollars. My projectionists having given me a report that a particular print had arrived badly scratched and with the edge on both sides ragged in several places, I at once sent a copy of it to the exchange. When later this exchange put in a claim for spoiled film I was able to show them the record from my files and later a board of arbitration exonerated me completely.

I know of other managers that follow the same close methods of cooperating with their projectionists and in every case the theatre has derived great benefit.

I might say here that I learned the value of this from my previous association with a large theatre chain as one of their managers just outside of New York. As is well known, most theatre chains have their projection in charge of a Chief of Projection, who is generally a very clever, experienced and technically informed projectionist himself. In our case nothing relating to projection was decided by anybody but our chief in New York. This involved everything, from the buying of new types of equipment not hitherto used in our projection room, to replacements and even to effect slides. Even these he selected for each show and sent on to us. I learned from him, though I never met him, the value of leaving such highly technical matters in the hands of men trained in them. I saw no reason later, when I worked for a small chain with no projection chief, and still later when I had my own theatre, why this couldn't be done with equal effect with my own projection crew.

In effect every projectionist in a theatre is a chief. Who knows better the state of the equipment, and who knows better what to advise?

It may seem childish to review the staff of my theatre to point the tale. But let us see: I employ two doormen to take tickets, two girls in the box office, two ushers and one porter. Then there is myself and my projection crew, consisting of two shifts of two men each. Now the most valuable part of my theatre is the projection room. There is where my heaviest "live" investment is. I say "live" because it is the only part of the theatre that requires a running operating expense outside of the film expense. Carbons, cells, replacements of heavy-duty equipment from time to time, etc. And also it is the heart of the theatre. If it stops beating for a moment, for an hour, for a day or longer, of what value are my seats, my screen and all the other appointments of my theatre? That is why I watch it anxiously so that its operation may be smooth and efficient.

Now my cashiers use no equipment other than the electric ticket machine. My doormen only tear tickets up and throw them in the chopper. Their jobs are mechanical. My porter is colored and my ushers are young girls. Shall I consult them about any technical matters?

Now I pay my projectionists a good wage and they seem satisfied to work for me. But I remember that when I came to this theatre I made it a point to enquire into their proficiency from sources outside the theatre. During my time I have had several new men, but I have always asked for the best men available.

I have taken it for granted that they were competent men with their work and their equipment. I am entirely ignorant of projection and do not know the first principles of the sound equipment. I was therefore compelled to look to them, to seek their advice on all matters pertaining to the most important, the most expensive part of my theatre.

I have interviewed many salesmen from supply houses and from manufacturers. Whenever possible I try to have at least one of my projectionists present at the interview. I never commit myself on projection equipment without them. Some salesmen have resented this, one of them going so far as to tell me buying projection equipment was my business, not my projectionist's. He was wrong.

In any case I have been thoroughly satisfied with the equipment I have bought at the suggestion of my projection room crew. Oh yes, they have made some errors in judgment, but in the long run I have saved myself considerable money by taking them into my confidence.

I must admit that it has not always worked in every case. I had one man at one time who never came to me. When I solicited his advice on projection matters I could get no satisfactory response. I put this down to shyness and made up my mind to cultivate him until he spoke his mind to me freely. But no amount of coaxing seemed to open him up. I then learned two things. First, he was unprogressive—that is he did not keep up with his own work by means of craft literature and technical information. Secondly, he was indifferent. He did his work efficiently, but he came on time and he left on the dot. Nothing else mattered. I was glad when he left me.

There are many such men in the projection ranks. Some of them, naturally friendly and loyal, have drawn into their shells because their first attempts at such cooperation at some time must have met with indifference upon the part of the theatre manager. They will respond to intelligent treatment. Others just don't care. But a general desire by theatre managers everywhere, in fact a demand, that projectionists cooperate and take the responsibility of deciding and determining the equipment factors in their projection rooms will awaken them to this responsibility and I know they will fullfill it completely.

Theatre managers are perhaps more to blame than their projectionists. They are not alert to the real intelligence in their projection departments and through their own mental stuffiness don't take advantage of it.

What a fool any theatre manager is to buy projection equipment without the advice of his projection crew and then suddenly to dump it into his projection room with some such implied remark as: "Here you are, fellows. Whether you think it's good or not you've got to use it."

Not me.

Drying Conditions in Photographic Density*

By D. R. WHITE

A SERIES of sensitometric tests has shown that the conditions of temperature and humidity surrounding film while drying can very materially affect the final photographic densities appearing on it. The effect of uneven drying in producing correspondingly uneven densities has been noted by a number of workers, and some hints of the need of control and standardization of drying conditions have appeared. A number of photographic workers have found that slow drying in warm air produces an increase of density tending to give an impression of overexposure and high contrast on films that would not have so appeared with other drying conditions. Although considerable effort has been expended in studying means of eliminating drying marks on film, there are little or no published data on the gross changes in density resulting from variations of drying conditions. The experiments presented here show that this gross effect, not a drying mark in the commonly accepted sense of the term, is by no means negligible.

The experimental work so far conducted has been limited to positive film. A series of developmnets were made with duplicate exposures. After development the tests were split, half being put into hypo with no hardener and half into hypo with chrome alum hardener. After fixing, the tests were washed together, and samples that had received treatment in each fixing bath were placed in a dryer operated under constant conditions, while other samples were placed in air that was conditioned specially as desired for that stage of the test. All these dryings were carried out in an air stream, not in stagnant air. Typical data are presented in Table I. The columns headed E and E' give density values resulting from two original exposures.

TABLE I

Effect of Drying Conditions on Contrast of Positive Film

Hypo—No Hardener

		Special Drying Conditions			*Standard Drying Condition* (Approx. 820—40%)		
Tem. °F.	*Rel.* H.,%	*E*	*E'*	Gamma	*E*	*E'*	Gamma
72	63	0.23	2.02	1.97	0.22	2.00	1.90
87	36	0.20	1.97	1.96	0.18	1.96	1.93
86	70	0.21	2.36	2.36	0.18	1.99	1.98
86	80	0.20	2.41	2.42	0.18	2.02	1.99
95	26	0.21	2.06	1.99	0.20	1.98	1.95
95	55	0.22	2.34	2.42	0.19	1.93	1.93
100	56	0.22	2.30	2.27	0.20	1.97	1.95
		Hypo—Chrome Alum Hardener					
72	63	0.23	2.01	1.93	0.26	2.08	1.98
87	36	0.21	1.98	1.98	0.20	2.04	2.02
86	70	0.24	2.34	2.29	0.20	2.02	2.04
86	80	0.21	2.44	2.49	0.18	2.00	1.99
95	26	0.22	2.04	1.95	0.20	2.02	2.01
95	55	0.21	2.34	2.28	0.18	2.00	1.98
100	56	0.22	2.31	2.30	0.20	2.02	2.00

The first and most important thing that this table shows, is the wide range of densities and gammas produced by the variation of drying conditions. While the control samples, dried under constant conditions, had ranged about 6 per cent in density and contrast, the specially dried samples had varied about 25 per cent. Second, the presence of hardener in the hypo did not affect these values, the two fixing formulas resulting in essentially identical results.

Figure 1 presents these data in a graphical manner. Values of gamma are placed close to the circles indicating the temperatures (plotted horizontally) and relative humidities (plotted vertically) at which the drying took place. These data, then, show that the density and gamma resulting from a development depend on the conditions surrounding the film while drying after development. High humidity and high temperature give greater density than lower values. The array of points plotted in Fig. 1 is not great enough to permit the complete determination of all the various combinations of temperature and humidity giving equivalent results, but lines drawn to represent such "equal effect" conditions would be of the nature shown dotted in the figure.

In the past, this drying effect, when considered at all, has apparently been considered primarily as a rate-of-drying phenomenon. These data show why this is so, since the higher humidities result in slower drying, other conditions being equal, and correspondingly higher densities result at temperatures of 85° F. and possibly lower. However, separate tests, in which the difference in drying rate was obtained by changing from moving to stagnant air, did not show any difference at about 72° F., although the drying time was some twenty times that used in drying the standard comparison samples. Thus the results here presented can not be explained primarily as a rate-of-drying effect.

All these data, however, conform to the view that higher densities result when drying takes place under such conditions as to soften the gelatin during the process. On this view, the cooling due to evaporation becomes an important factor. When the humidity

---

* *By permission of Society of Motion Picture Engineers.*

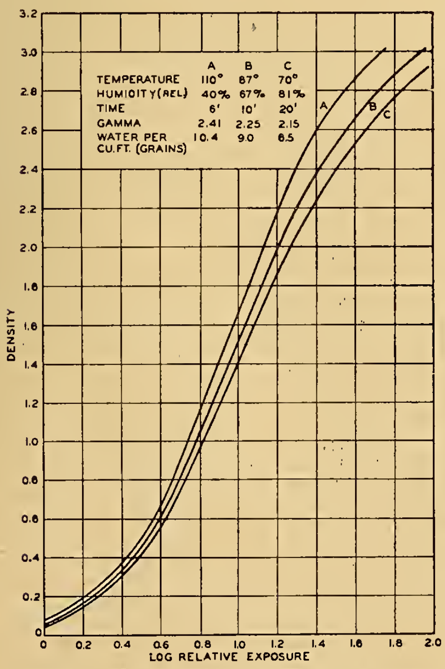


FIG. 1. (Of discussion) Effect of drying in air of low absolute humidity.

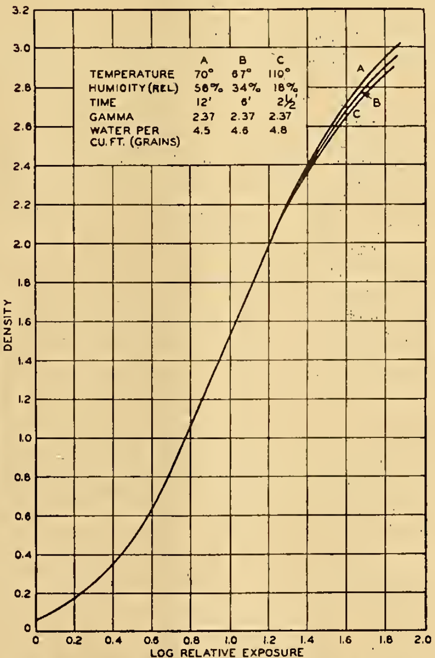


FIG. 2. (Of discussion) Effect of drying in air of moderate absolute humidity.

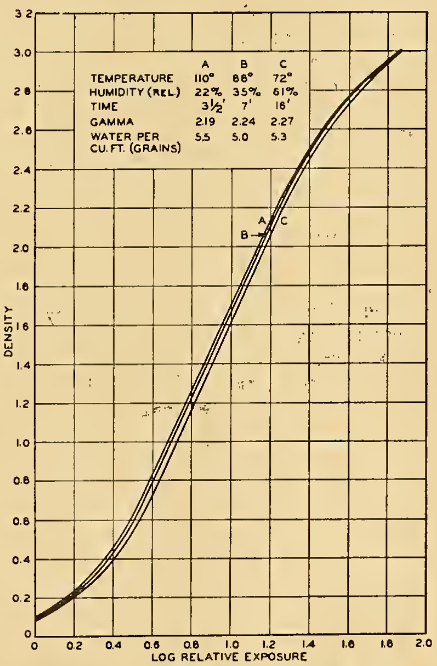


FIG. 3. (Of discussion) Effect of drying in air of high absolute humidity.

is low, the cooling is great enough to keep the gelatin firm even at the higher air temperatures; but when the humidity increases, the cooling is not as great and a corresponding softening of the gelatin takes place. This permits a rearrangement of the somewhat plate-like grains, and results in higher density from the same amount of silver. This view is at least qualitatively in agreement with Crabtree's suggestion that softening of the gelatin is an important factor in the "drying down" effect that he notes, which appears to be the same effect described here in greater detail.

As a further test to determine the effect of softening of the gelatin, strips were developed and fixed in the usual way, but were washed in water of different temperatures before drying. Table II shows the results of this test. Of course, the action of the water does not accurately parallel the effect of the varied drying conditions, but it is very suggestive to note that similar differences in final density resulted from these treatments.

TABLE II

Effect of Washing Conditions on Contrast of Positive Film

Washing Conditions	E	E′	Gamma
40′ at 52°	0.18	1.93	1.97
10′ at 52° + 30′ at 75°	0.20	2.03	2.06
30′ at 60°	0.19	1.89	1.82
30′ at 80°	0.19	2.10	2.07
30′ at 52°	0.17	1.90	1.92
10′ at 52° + 20′ at 85°	0.18	2.12	2.20

This drying effect is important both to scientific and commercial workers. It is evident from these data that the photometric constant, usually expressed in milligrams of silver per unit area for unit density, is dependent upon the drying conditions of the film. This fact may account for some of the differences in published values, although other factors, such as the variation of grain structure, may account for much of these differences. Again, standardization of sensitometry from place to place and time to time should recognize, and remove or allow for, this effect as a source of error. Recent literature on sensitometry is silent on this point, in spite of the fact that the suggestion of the need of standardization of drying was made at least seven years ago.

Commercially, with present-day processing technic, this work emphasizes the need of maintaining uniform drying conditions at some one level in order to achieve uniformity of results. Again, in order that tests and experiments may parallel routine procedure, the drying must be kept similar to the routine drying. It is probable that at the lower temperatures and humidities relatively stable conditions are reached, such that small variations of tempearture or humidity have less effect than at the higher values. If so, there would be some advantage in using those conditions for drying film, as departures from the intended values would have correspondingly less effect there.

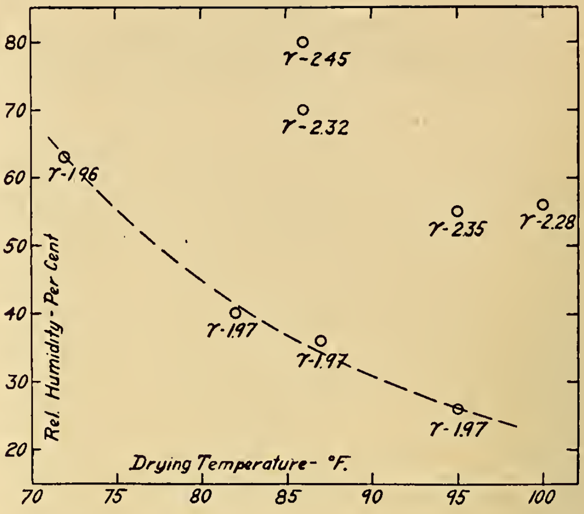


FIG. 1. Effect of drying conditions on contrast of positive film.

The Cellulose Screen*

By V. WALKER

THE transparency projection process has within the past few years gained universal recognition as one of the most outstandingly adaptable special photographic or "trick" processes ever devised. Since it is, therefore, in every-day use in practically every studio, any detailed discussion of the process itself at this time would be merely an unnecessary repetition of what is already well known; however, in order to avoid any misconception, it may be well to recall that this process involves the use of a large, sandblasted glass screen, upon which is projected the desired moving background, which is rephotographed, together with the foreground action by a standard camera operating in synchronism with the projector.

There have been however definite physical limitations to this process. In the first place it is extremely difficult to procure satisfactory glass screens of large size; this of course, definitely limits the utility of the process, as well as adding to the expense. It has heretofore appeared to be practically impossible to eliminate a very noticeable "hot spot" or area of increased illumination at the centre of the screen; all manner of expedients have been tried, including different types of surfacing, double and single-sided screens, and the like, but with little practical success. Lastly, the bulk and fragility of the glass screen—especially the larger ones—have raised many serious problems; most important have been the matters of danger and replacement, for a number of serious injuries have been occasioned by inadvertent breakage of these huge glasss, and, quite aside from the element of danger, the glasses are so fragile as to be non-insurable, while, under existing conditions, replacements are almost unobtainable.

The appearance, therefore, of a non-breakable, inexpensive, non-vitreous screen for this work is a development of an importance second only to the invention of the projection process itself.

Such a screen has been developed and is now in actual use at the R-K-O Studio in Hollywood. It was perfected by Sidney Saunders, an engineer in the Studio's Mechanical Department. A number of the new screens are being installed in the special-effects departments of other studios.

The new screen is of a cellulose composition somewhat akin to the familiar "Cellophane" used in the wrapping of many commercial products. In appearance, the Saunders Screen resembles a large sheet of waterproofed canvas; in use, it is stretched in a frame much as a sheet of canvas would be. It is flexible, non-breakable, inexpensive, and —unlike many cellulose products—particularly non-inflammable; it is actually impervious to anything but an open flame. Any heat sufficient to cause it to ignite would be more than sufficient to trip the regular automatic sprinkler system on the stage. These screens can be made in practically any size; the one in use at the R-K-O Studio is sixteen by twenty feet—more than two feet larger in each dimension than the largst glass installation. A still more recent installation measures 17 x 22 feet.

Most important of all however, are the definite advantages shown in the completed process shots made with this new screen. The objectionable "hot spot" is reduced by more than 50%, while the overall brilliancy of the projected picture is increased by better than 20%, and the projector-current can be proportionately reduced. This, translated into practical working terms, means that the cinematographer has a far greater freedom in both the lighting of his foreground action and the balancing of the projected background with the foreground lighting. Moreover, the results obtainable with the new screen are far superior in trueness and gradation to the best obtainable with glass screens. The highlights, for instance, which are more or less greyed with sand-blasted glass screens, are a true white with the Saunders screen, while blacks, on the other hand are more intense.

—Reprinted from American Cinematographer.

Model Building Code for Theatres

PROJECTION ROOM REQUIREMENTS

BUILDING Codes in a great many cities of the United States have been allowed to stand as they were first written, anywhere from ten to forty years ago, notwithstanding the great advances made in building construction, fire preventative improvements, and present day engineering achievements. For months past a representative committee has been at work in New York City revising the outdated Building Code, many of the provisions of which were written some forty years ago, long before motion pictures were thought of.

The committee has concluded its work and has offered to the city a revised Building Code having to do with theatre construction that may well be taken as a basis for similar codes in other cities. While the recommendations contained in this report have not, as yet, become official, they are of such character that they will undoubtably be accepted with but few changes and certainly form an excellent theatre building code which can profitably be incorporated in the building laws of all cities.

The Motion Picture Projectionist is pleased to publish here those sections of this important document that refer to the construction and maintenance of projection rooms and all that pertain thereto. In this day when so many projectionists act as consultants to architects and theatre owners on the proper layout and construction of projection rooms and projection equipment ,this resume will be of extreme value and importance.

Picture Theatre

A public hall or room for the display of motion pictures with a seating capacity of 600 persons or less and without stage or scenery is a motion picture theatre. The construction or use of such a theatre is forbidden in any frame structure; or in a factory, except where the theatre is separated from the rest of the structure by unpierced walls and floors having a fire resistive rating of at least four hours; or in a multiple dwelling of less fire resistive type of construction than Class 1, Fireproof Structures. Such theatres shall be constructed on the ground floor only.

Booths Required.

The use of any cinematograph or other apparatus for projecting moving pictures which uses easily flammable films more than 10 inches in length is forbidden in any structure, place of public assembly or entertainment unless such projecting apparatus is enclosed in a booth constructed of incombustible materials.

Construction and Specifications.

The booths required shall be constructed according to approved plans and specifications. Plans and specifications for such booths shall be approved only when they provide substantially for the following requirements:

Such booths shall be at least 7 feet in height. If one machine is to be operated in such a booth the floor space shall be at least 7½ by 10 feet. If more than one machine is to be operated therein, 24 additional square feet shall be provided for each additional machine.

Permanent booths shall be constructed of incombustible materials having a fire resistive rating of at least *three* hours. If temporary booths are constructed of incombustible materials other than masonry or asbestos, they shall be constructed of angle framework of approved incombustible material. The angles shall be at least 1¼ by 3/16 inches and the adjacent members shall be joined firmly with metal angle plates. The maximum distance between angle members of the framework shall be 4 feet on the sides and 3 feet on the front, rear and top of the booth. The sheets of asbestos board or other approved incombustible material shall be at least ¼ inch thick and shall be securely fastened to the framework with metal bolts or rivets. The incombustible material shall completely cover the sides, top and all joints of the booth. The floor space occupied by the booth shall be covered with incombustible material at least ⅜ of an inch thick.

All booths shall be so insulated as not to conduct electricity to any part of the structure. Booths shall be provided with two means of egress consisting of passageways, stairs or ladders and located one at each end of the booth. One of these means of egress shall be through a door at least 24 inches wide and 70 inches high. All such doors shall be self-closing and shall open in the direction of egress.

One operating window shall be provided for each machine and one for each operator. Such windows shall be as small as will permit the necessary service, and shutters of approved incombustible material shall be provided for each window. The shutters shall be so arranged as in the event of fire to close the window openings automatically by the operation of approved fusible and manual releasing devices.

Where a booth is built against the exterior wall of a structure, a window shall be permitted in such wall for the comfort of the operator. Booths shall contain an approved box of incombustible material for the storage of films not on the projecting machine. The storage of films in any other place on the premises is forbidden. Films shall be rewound and repaired either in the booth or in some other enclosure made of incombustible materials, but the room in which motion picture machines are operated shall be separated from the rewinding and other accessory rooms by fireproof partitions provided with self-closing fireproof doors. Booths in which projecting machines are operated shall be provided with separate opening or vent flue in the roof, or upper part of its side wall, leading to the outer air from the rewinding room and from the machine room. Such flues shall be at least 50 square inches in cross section and made of incombustible materials. When booths are in use a currentof air at the minimum rate of 30 cubic feet per minute shall be maintained through the booth to the outer air, and sufficient to furnish a complete change of air every ten minutes.

Existing Booths.

Existing booths, legally installed and approved shall be exempted from other requirements provided they are constructed of rigid incombustible material so insulated as not to conduct electricity to any other part of the structure, so separated from any adjacent combustible materials as to prevent the communication of fire through intense heat in the case of combustion within a booth and comply with specifications in respect to dimensions, vent flues, boxes for storage of films and for windows and doors.

Inspection.

After the construction of a booth has been completed the Superintendent shall, within 3 days after receipt of written notice of that fact, cause such booth to be inspected. If the provisions have been complied with the Superintendent shall issue to the owner or lessee of the premises on which th booth is located a certificate to that effect.

Portable Booths.

Where motion pictures are exhibited daily for one month or less, or at most 3 times a week in educational or religious institutions or bona fide social, scientific, political or athletic clubs, a portable booth may be used. Such portable booths shall be at least 6 feet high and at least 20 square feet in area, and shall be constructed of asbestos board, sheet steel of at least No. 24 United States Gage, or of other approved incombustible material. Such portable booths shall comply with requirements with reference to windows and doors, but are exempted from the requirements for vent flues. The floors of such booths shall be lifted at least one-half inch above the permanent support on which they are placed and sufficiently to allow the passage of air between the floor of such booths and the platform on which they rest, and they shall be so insulated as to prevent the conduction of electricity to any other portion of the building.

Exemption.

Miniature motion picture machines in which the maximum electric current used for the light is 350 watts are exempted from the above requirements. Such miniature machines shall be operated in an approved box of incombustible material constructed with a fusible link or other approved releasing device to close instantaneously and completely enclosed in a metal lantern box covered with non-removable roof. Miniature motion picture apparatus, which uses only an enclosed incandescent electric lamp and approved acetate of cellulose or slow burning films and is of such construction that films ordinarily used on full sized commercial picture apparatus cannot be used are likewise exempted from the above requirements.

How Many Can You Solve Yourself?

Since talking pictures replaced silent films, sound heads, amplifiers and speakers have claimed much of the projectionist's attention. And this quite rightly since the competent projectionist should be familiar with the entire installation.

However, the projectionist should not forget that the motion picture projector is still essentially what its name implies and that on its smooth functioning as such good sound reproduction is dependent.

The uninterrupted operation of the projection equipment is something entirely within the projectionist's responsibility.

The following is a list of "troubles" which may develop in the most modern motion picture equipment. How many of them can you solve yourself?

ARC CONTROLLER:

Device operates poorly
Device fails to operate
Device continues to operate after the table Switch is opened.

BELL OR BUZZER SIGNAL SYSTEM:

Bell (or buzzer) does not operate
Device operates intermittently
Bell (or buzzer) sounds continuously
System works when new battery is used, but soon fails to operate

DOUSERS:

Dousers open and close too early or too late
Dousers fail to operate
Dousers open or close too far

FILM:

Film is unusually dry or brittle
Film adheres in spots
Film adheres throughout its entire length

FILM DURING PROJECTION:

Film pulls apart in the Projector
Film runs off sprocket damaging film
Film pulls apart where old style friction takeup is used.
Film rips and tears while being projected

FILM: (INSPECTION AFTER RUNNING)

Damage noted in film after the first run—in new film especially

FILM: (AFTER REWINDING)

Film shows tears and nicks
Film is unusually dirty and dusty after rewinding
"Rain" develops while running the film
"Rain" develops while rewinding

FUSES:

Fuse blows out
New fuse blows after an interval
New fuse does not blow out but the line remains dead
Fuses blow out when arc is struck (where 3-wire system is used)

HOUSE LIGHTS:

Some lights burn too brightly, others are too dim at same time.
Emergency lights go out, house lights still burn.

LAMPHOUSE:

Lamphouse is "live" (It is charged with electricity and produces a shock if touched)
Lamphouse becomes overheated

LAMP MECHANISM:

Moving parts of the lamp work with difficulty
Arcing occurs between carbon and jaws
Carbon jaws pit and roughen

HIGH INTENSITY LAMP: (MECHANICAL TROUBLES)

H. I. Hand feed work with difficulty
Emergency: Arc current fails when using D.C.
H. I. Positive carbon fails to feed
Positive carbon fails to rotate or turn in shield.
One carbon burns out quicker than the other

MAZDA FILAMENT LAMP: (MECHANICAL TROUBLES)

Mirror breaks upon insertion or soon afterwards.
Mirror looks dull or dirty

REFLECTOR ARC LAMP: (MECHANICAL TROUBLES)

Mirror backing continually chips or flakes off
Mirror surface pits
Occasional aperture fires occur when using Reflector Arc

LIGHT SOURCE:

No current at arc
Series arc: One goes out when other arc is struck
Polarity changes so that upper carbon becomes negative
Brilliance of arc seems less than usual
Arc is very unsteady
Arc unsteady, with H. I. Lamp
A. C. Arc very noisy
Arc flames badly and burns in a puffy manner
Arc fluctuates though carbons are right and contacts clean and tight.
Arc unstable, even goes out, with Reflector Arc Lamps.
Arc amperage very high (Excessive) when arc is struck, becomes normal after arm burns awhile.

LIGHT SOURCE: (CARBONS)

Crater "Wanders" about
Carbons have very short life
Short carbon life with H. I.
Crater area is small
Carbon needles, spindles and pencils
Carbon shattered by striking Arc
Carbon develops mushroom (button) point (also known as "Freezing of Arc")
Carbon Core burns away, recesses
Carbon core blows out
Carbons cause sputtering, hissing
Carbons burn with Lip or Overhang
Carbon "Lips" when using Reflector Arc

LIGHT SOURCE: (FILAMENT LAMPS)

Bulb looks blackened
Dark spot shows in Filament Coils
Lamps have very short life
Mirror images do not fall exactly between Filament images.
Lamp is blown out when Projector Table Switch is pulled.

LENSES: (OPTICAL TRAIN)

Condenser breakage excessive
Condensers become discolored
Condensers pit badly
Lenses seem streaky
Rear element retaining ring binds when element is removed for cleaning.

MERCURY ARC RECTIFIER:

Rectifier does not work on starting up
Tube does not tilt
When tilted by hand, tube does not start; when tilted by shaking magnet, tube does not tilt
Tube lights, but goes out
Tube is tilted by shaking magnet but does not return to vertical position
Tube tilts and returns but does not flash
Tube tilts, flashes, then goes out
Tube tilts feebly
Tube starts and keeps on tilting
Device is very noisy

MOTORS AND MOTOR GENERATORS:

Undue wear and other damages show up
Coils and winding, especially around Commutator, seem damaged. Weakened insulation is visible.

BEARING:

Ball bearings are roughened or completely ruined
Bearings show undue wear
Bearings are grooved
Brushes wear excessively
Brushes stick in holders
Brushes make poor contact
"Bucking" (Arcing between adjacent brush arms)

STARTING TROUBLES:

Device fails to start when proper starting instructions are followed
Set operates but does not attain full speed
Motor revolves in wrong direction
Set does not pick up readily
Set does not deliver full voltage

OPERATION OF SET:

Set loses original efficiency
Set is noisy
Unusual bad vibration
Motor does not deliver desired amperage
Motor does not deliver desired voltage
Characteristics of set change when new brushes are installed
Whole set seems to overheat

ARMATURE TROUBLES:

Armature overheats
Armature wabbles
Armature heats up suddenly

BALL BEARING:

Ball bearings leak oil
Sleeve bearings leak oil
Sleeve bearings heat-up
Ball bearings run noisly and show wear
Waste packed bearings heat-up

COMMUTATOR TROUBLES:

Commutator bars are short circuited
Commutator overheats
Commutator is grooved
Commutator is cut and rough
Commutator shows ring of fire all around

FIELD COILS:

Field coils overheat

SPARKING:

VOLTAGE:

Voltage fluctuates badly
Voltage does not build up as it should when set is started
Low Voltage continues
Voltage builds although set is running idle (Series arc. equipment)

PICTURE DEFECTS:

Action is not natural, but is fast, small, jerky, etc.
Clearness of picture is reduced after lenses are removed and replaced
Clearness of picture is reduced after new lens is installed
Definition becomes poor, clearness is reduced
Flashes of white light show on screen during projection

FLICKER:

Flicker shows when new screen has been installed
Flicker noticeable when amperage is increased
Flicker increases when size of picture is increased
Flicker noticeable with two-wing shutter
Flicker is noticeable when projection speed is reduced

FOCUS:

Focus is not sharp: Keystone effect is pronounced
Focus appears sharp from projection room, but is poor in parts of auditorium
Focus bad, out of focus, in-and-out effect

LIGHT CONDITIONS AND THEIR EFFECT ON THE SCREEN:

Blue spot in picture or in light in center of screen.
Definition of picture poor
Detail lacking in screen result
Dirty, smoky, smudgy, light effect on screen
Light seems to get bright and fade away with A.C. arc
Light on screen poor with Mazda
Lacking detail in picture with Mazda
Light unusually poor with Mazda
Poor light with High Intensity Arc
Uneven, unsteady high intensity light
Poor lighting with Reflector Arc
Lighting glarey and harsh when light source is changed
Glare spots show up
Gray, flat picture; no contrast
Light shows outside screen area
Light loses brilliancy
Picture less brilliant at some points in auditorium than in others
Light streaky with Mazda projection
Shadow appears near top, bottom, or side of screen
Unsteady picture
Unsteadiness, side motion of picture
Unsteady picture although Projector is in perfect adjustment
Picture seems to float about on screen

TRAVEL GHOST:

Travel ghost shows up
Travel ghost comes and disappears
Travel ghost pronounced
Travel ghost; picture seems to crawl up on screen
Uneven light. Noticeable most on plain screen

STEREOPTICON TROUBLES: (NOTICEABLE ON THE SCREEN)

Stereoptican picture smudgy looking
Ghost in center of stereoptican picture
Yellow corners in stereoptican picture
Both pictures of dissolving stereoptican fail to be in register
Stereoptican device shows break in a condenser although projector does not
Shadow of carbons and (or) holder appear when using reflector arc for stereoptican
Stereoptican slides crack excessively

PROJECTOR:

Fire shutter (automatic) sluggish
Fire shutter rises slowly, drops too soon if speed is slightly reduced
Fire shutter fails to work
Film buckles
Film climbs sprocket
Friction drive of arc controller or motor drive wears excessively
Friction material develops flat spots
Friction drive fails to operate projector
Friction drive operates off and on

A Definition of Astigmatism

RESEARCH DEPARTMENT, BAUSCH and LOMB

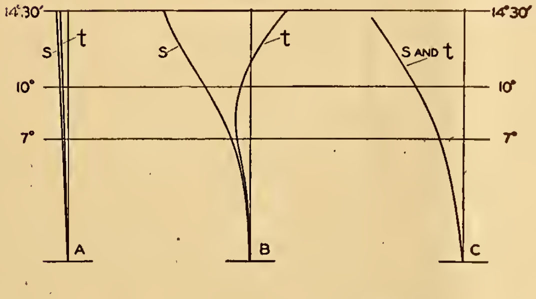


FIG. 1

AN anastigmat is a lens which has been fully corrected for astigmatism as well as spherical aberration and color aberration.

It is an unfortunate provision of nature that a single lens, applied to the task of forming an image, gives us an image about as far from the quality we want as could well be and still have it recognizable as an image. The ideal image is the true projection of the object spaces onto a plane, such a projection as might be constructed by drawing single lines from every point in the object space through a pinhole and continuing them until they intersect the desired plane of projection. The image formed by a lens differs from this ideal in many respects. In the case of the pinhole, the image is equally sharp no matter at what distance from it lies the plane of projection, for it is assumed to be so small that only a single ray of light from any one object point can pass through it. The lens, however, is of finite size and many rays from any one object point are received by the lens. For perfect performance all these rays coming from any one object point should be reunited by the lens in another point on the desired plane of projection (the focal plane of the lens). It happens otherwise, however, as illustrated in figure 2. Here there is represented an object point O lying in the margin of the field. Instead of the lens forming a point image of O, it forms as the nearest approach to it an elliptical spot of light at O'. If we explore the cone of light in the neighborhood of O', we find that it nowhere comes to a point focus. At the place marked t in the diagram the light seems to be concentrated in a short line as indicated and, at another place, such as s, it again seems to be concentrated into another line at right angles to the line at t. t is the focus for the meridian of the lens marked t, and s is the focus for the corresponding meridian of the lens.

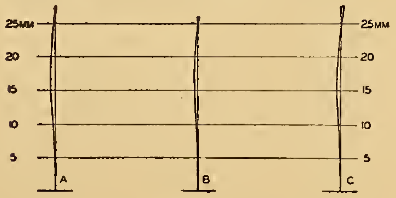


FIG. 3

The phenomenon of the representation by the lens of object point O as a pair of perpendicular lines is called astigmatism. The distance from O to the center of the distance between t and s is the curvature of field for the lens for this angle. The astrigmatic difference (distance between t and s) and the curvature of field will vary from point to point over the field depending on the angle of the field of view. The focus of all points t and s is a pair of curved surfaces which constitute the image of the object plane. These surfaces are indicated by the dotted curves connecting t and s in the figure with the center of the image.

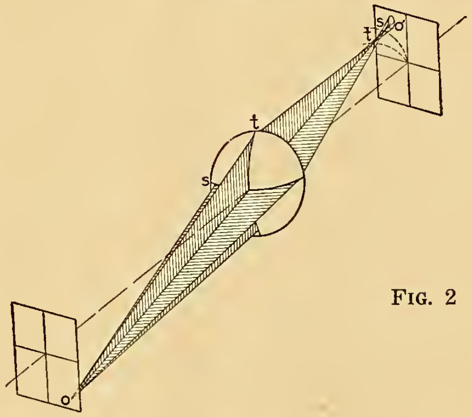


FIG. 2

By using more than a single lens, compounding, diverging and converging elements, and choosing glass and curvatures of surfaces to the best advantage, it is possible to overcome or "correct" astigmatism and curvature of field. Different lens constructions lead to different degrees of correction.

At C in figure 1, we have the curve plotted for a lens of that general type characterized by a short back focus; surfaces s and t (figure 2) have been brought together, but they form a focal surface that is badly curved. These curves were obtained using a lens of this type procurable on the open market. B, figure 1, shows the curve of the Cinephor in which the focal surfaces practically coincide and are fairly flat up to an angle of 7 degrees and then diverge. At A, the curve of the Super Cinephor becomes almost perfect; this lens forms a focal surface almost a plane up to 14 degrees, 30 minutes.

To add to the significance of the curves, it is well to take into consideration the fact that for standard film the angular field of view of a 5 inch focus lens is about 14 degrees, and for a 4 inch lens about 18 degrees. For wide film the corresponding values are 23 degrees and 29 degrees. Since the curves in figure 1 are plotted for distance from the center of the field (half the total field) the above figures should be divided by two for reference to the curves.

Anastigmats have not hitherto found favor for projection because, for large relative apertures, the correction for astigmatism and curvature of field has been obtained at the sacrifice of definition in the center of the field. The construction used in the Super Cinephor, however, permits central definition equal to that afforded by the prevailing types of lenses in addition to the excellent flatness of field. This is shown in figure 3, which contains curves representing the spherical aberration for the three types of lenses described above.

The importance of spherical aberration should be emphasized. It is illustrated in figure 4, which shows parallel light entering a simple lens and being focused at different places along the axis instead of at a point. Spherical aberration occurs in all uncorrected lenses, preventing them from forming sharp images. The outlines of the details in the field wil be blurred, and black areas will be more or less gray instead of black. Good lenses are carefully corrected for spherical aberration.

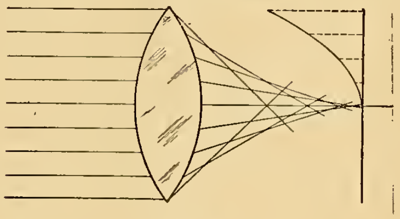


FIG. 4

Figure 3 shows at a glance that there is practically no difference between these three kinds of lenses when considering spherical aberration, and that the superior performance of the Super Cinephor in respect to its correction for astigmatism and flatness of field has been attained without sacrificing definition in the center of the field. In other words, no essential quality has been sacrificed in gaining the type of correction found in the Super Cinephor.

HOW TO "SHOOT" TROUBLES ON
YOUR PROJECTION EQUIPMENT

BUY READ and USE

SERVICING PROJECTION EQUIPMENT

A very useful book, designed and written only for the motion picture projectionist . . . as handy and as necessary as any tool . . . already many hundreds of copies are working over-time in as many projection rooms.

This book can be had today for $1.00. There are no strings attached to this unusual offer. We pay all postage.

Get your copy at once. Fill in your name and address in the coupon below, pin a dollar bill to it, insert in enveope and mail to the Mancall Publishing Corp.

CUT OUT - FILL IN - MAIL AT ONCE

Servicing Projection Equipment

Last Copies

$1.00 Only

Name ....

Street ....

City ....

State ....

Published by
MANCALL PUBLISHING CORP.
7 W. 44th STREET
NEW YORK CITY

Union of Sound with Color

By L. M. DIETERICH

The efforts of creating motion pictures, to faithfully reproduce natural vision within the limits of present methods of screen projection, are in the direction of combining sound with color.

Sound reproduction, restricted by the even ultimate possibilities of at present known methods, so far renders in its best results fairly satisfactory results.

Assuming, however, that both sound and color reproductions would develop each by itself, to a condition of faithful imitation of nature, then the synaesthetic properties of human sense reaction should be well considered.

Synaesthesia in its broad sense means the automatic exciting of a sense organ by the functioning of another sense organ.

This automatic reaction is a combination of physiological and psychological phenomena.

To the knowledge of the author, synaesthesia has, as far as sound and color are concerned, in the arts, and certainly in the motion picture art, never been the basis of profound study or systematic application or use.

And yet, wherever outstanding impressive harmonies of sound and color were produced, either accidentally or by the unconscious "genius" of the human creator, then synaesthesia was active.

Before this constant repetition of that mysterious word synaesthesia, however, produces any anaesthesia in the reader, it might be well to try to clarify its practical characteristics, at least as far as sound and color are concerned and then suggest a method of application to motion pictures.

It is well known that musical arts, the sound qualities of human speech, as well as the color arts, have a decided emotional effect.

Interest, pleasure or displeasure, fascination, delight, love in its platonic or sexual beauty, or perversity—the whole gamut of emotional reactions are influenced by both sound and color.

The same effects of sense pleasure or displeasure have been and are continuously felt by all of us even under the simple conditions of looking into a store show window or listening to the radio, and in a more sophisticated endeavor, by visiting a museum of the fine arts or attending a philharmonic orchestra concert.

One of the most convincing demonstrations of the synaesthetic relationship between sound and color is the combination of a color organ display with accompanying music,.

It produces an uncanny, mysterious sequence of sense emotions and can sway the mind of the audience to practically any height or depth of emotion, desired by performers of skill and thorough knowledge of psychological reactions.

It may at this point be mentioned that the comparative study of the sensitivity curves of both the human eye and ear are of great assistance in the valuation of sound and color synaesthesia, keeping in mind the influence of intensity upon the acoustic sensitivity curve under the usual rapid fluctuations of intensity in music.

Let us assume that we realize these existing and active sense reactions, then we should analyze both such sound and color reactions in order to be able to harmoniously combine them or choose the then known characteristics of one sense impression to properly co-act with certain characteristics of the impression upon the other sense in order to enhance and not to diminish or destroy the desired effect.

It is well known, for example, that the "brilliant" hues of the warm color scale, like yellow and red, are entirely in harmony with "brilliant" martial music of strident tones and that the soothing effect of deep greens and blue-greens of the cold color scale blend well with a languid serenade. A funeral march and a gay beach scene, however, would certainly not be a pleasant combination of sense reactions, whatever the inherent beauty of either one may be.

Let us consider, as a supposition, a motion picture scene with sound and color, wherein a wharf scene is shown and wherein the dramatics call, as a pictorial detail, for an outstanding effect for a red roof and as a sound detail for the voice of a female street singer, a supposedly so far undiscovered marvelous soprano.

The art director, well versed in color effects, will, of course, make the selection of the red hue of the roof in accordance with its structure, a tile roof rather than a shingle roof for brilliance effect and select the contrast reaction of the values of surrounding objects as near as possible of complementary colors to produce the final effect of outstanding attraction concentrated upon this roof detail. This art, in short, produces in the spectator the desired dramatic effect the author strives for. This is, however, the total effect of the silnt picture only.

If at the start of this crowded wharf scene an accumulation of discordant noises, with the synaesthetic impression of foul smells and dirt, impress themselves upon the spectator, the brilliance of the red roof has materially declined.

An organ grinder appears on the scene and the listener hears and is attracted by a pleasing, lively tune. The red roof immediately appears to be of a brighter hue. The street singer, clad in lively colors, starts to sing. She sings a passionate love song supported by a marvelous voice. The red roof now appears with the same dramatic brilliance which the author and supporting art director are striving for and this brilliant effect reacts vice versa synaesthetically upon the dramatic effect of this love song and enhances the beauty effect and dramatic value of the singers' voice.

If the composer or music director, however, would be convinced that the specific star singer's voice would, in itself, be most effective in a character song of ribald drunkenness, including contrast disharmonics — the singer might be most impressive in herself—but the red of the roof would lose its brilliance, its dramatic effect would decline and, vice versa, take the snap out of the singer's voice.

If such a song, however, is a necessity, as well as the brilliance of the roof, then both effects must beforehand be stepped up in order to maintain the final cooperative dramatic effect of these two sense impressions of both sound and color.

These considerations are well in line with the dramatic art employed in properly harmonizing music and song with the libretto, scenery, and acting ability of the performers of, as an example, grand opera, but have so far been woefully neglected in the composition of colored sound motion pictures.

It must be repeated, however, that the imperfections of sound and especially color renditions in this new art have been and are so far a serious handicap to properly employ sound and color synaesthesia to motion pictures.

At the same time, the author feels that scenario writers, directors, art directors and composers or music directors should not neglect to include into their cooperative efforts a study of this little known physio-psychological human property of synaesthesia.

The present decline of public interest in motion pictures is spurring all producing agencies throughout this industry into well nigh desperate efforts to increase so-called box office values, which are nothing else but the automatic reaction of the public to satisfactory and rising entertainment values and sense pleasures.

Every element contributing to such favorable public reaction must be, therefore, studied, and if possible employed and it is for this reason that this short analysis of synaesthesia is offered to the motion picture industry at large for consideration and study and don't forget, "You can and do see a tone and hear a color."

---

* *Reprinted from The American Cinematographer.*

Use of Color

The use of color in *all* films as sound is now used in all films has intrigued the imagination of film craftsmen and public alike. It is inevitably the next step in motion picture development. Its use thus far has been spasmodic and commercialized as a novelty rather than as a necessity of motion pictures. Further advancement of the technique of applying color is also necessary. This will follow as a natural result of the development of natural colors that are as unobstrusive and easy on the eyes as colors in real life.

Needed: A Society for Projectionists

By KARL FULLER

THERE has been so much said and written about the fact that projectionists are skilled craftsmen, working with the most precise and scientific tools, that it is most surprising that nowhere in this country is there a society or organization devoted to a continuous study of projection problems designed to raise working standards and conditions and to offer suggestions for the improvement of the equipment.

You hear of such organizations in other industries whose basis is likewise imbedded deep in scientific fact. You hear of Chemical Societies and societies of textile engineers, mechanical engineers, radio engineers and so on down the line. But today there exists no organization working solely for the good of projectionists and what is more important made up wholly of projectionists.

It is true that there is the Society of Motion Picture Engineers which is rated very high in the scientific world and which has accomplished much good for the motion picture art. There is also the Academy of Motion Picture Arts and Sciences in Hollywood which is probably the most efficient of all such bodies, functioning now or which have functioned in the past in the motion picture industry. But neither of these organizations is concerned solely with projection.

None Successful

Within projection ranks there have been several attempts in the past to build up such organizations but today they are either out of existence or are dormant for want of funds or leadership. I recall the American Projection Society and also the Projection Advisory Council.

In the early days of projection the American Projection Society wielded considerable influenece and counted among its members some of the ablest projectionists of the country. F. R. Richardson, though not a practicing projectionist, was a member of this group and his influence was and still is wide and powerful. There were others who left their mark.

But even in its most influential days the American Projection Society was only partially organized and failed to reach many parts where instruction and guidance in projection work was even more necessary than in the big cities where its few chapters were functioning. It is my opinion that it spent its strength in the wrong direction: that is instead of setting up chapters which held a charter from the parent body in New York but otherwise functioned independently, it should have built up a strong single organization which would have worked for the whole country and sent its findings everywhere. Its meeting, as in the case of the Motion Picture Engineers, could have been held in various parts of the country in order to give it true national character.

The Projection Advisory Council failed because it was never clear as to its intent and direction.

In the first place it was greatly concerned with getting publicity notices in the daily press boosting projection and projectionists. Now that in itself is a very worthwhile work but in the first place that would have come as a matter of course whenever the acts of projectionists deserved credit. As a matter of fact, that is just what happened—for the council lifted published notices from local papers and attempted ineffectively to get national publicity out of them. In the second place it failed to recognize that it should have striven mightily within projection ranks, lending the weight of whatever authority it had to raise standards and conditions and morale internally.

It was a paper organization from the first. Although some projectionists allowed their names to be used as members of committees and as officials, very little work was done and nothing was accomplished.

In any case this organization is dead today. If it is ever revived let us hope that it will find itself under more capable leadership which will recognize the real needs of projectionists and intelligent enough to work constructively.

Support Will Come

It has been said that educational societies of projectionists have failed because not enough projectionists could be interested to make them self-supporting. That is a fair indictment but it fails to recognize that support would be forthcoming in sufficient measure if its value to the craft was unmistakable and its work added further proof. A good example is the Society of Motion Picture Engineers. Before depression days the size of the active membership alone was enough to support its activities. Now that its membership has fallen off big organizations have come to the fore with cash contributions to keep the society alive and functioning. That could not have happened if its work was not its best justification.

At present the field of projection shows some 500-odd small units (local unions of the I. A. T. S. E.) standing shoulder to shoulder and fighting as one against any outside factor that threatens to break down their rights and privileges as organized laboring men. But viewed from any other activity, educational and otherwise, projectionists are drifting helplessly in a sea of uncertainty and isolation. Educational facts seep into the craft only through such publications as are devoted to projection. In this connection the MOTION PICTURE PROJECTIONIST deserves special credit as it was the first attempt at a national publication in the whole history of projection and has done consistently splendid work.

I have thought that the Society of Motion Picture Engineers should lay more stress on projection technique and projectionist members than it has done so far. Perhaps with a modified paper and membership policy it could attract thousands of projectionists who would support the Society financially and benefit by its work.

I would like to commend some such plan to the Society.

A Suggested Plan

For instance, it is my opinion, and I have heard it often from other projectionists, that its membership fees are much too high. If they were lowered many of us would join up. The Society now has several grades of membership but I would suggest that all grades be merged into one or else be changed to two only, one for engineers and others associated with organizations outside of projection ranks and the other devoted solely to projectionists. The latter memberships should be very low—say no more than $5.00 a year. This would entitle them—or should—to receive the journal of the Society for a period of one year and thus they could keep informed of th latest developments in projection equipment and technique and other related subjects. I believe that this low membership fee would bring projectionists into the Society.

But to make projectionist membership justifiable, the Society will have to include many more papers on projection and perhaps devote at least one of its meetings, or a special meeting annually, to projection matters only. And even more important—projectionists should be invited to contribute and read papers at these meetings. I believe that the Society has failed to recognize that among projectionists are men of keen mind and that many of them are responsible for the real progress that has been made in projection. I am sure there are many who will agree with me that many of the improvements now to be found on standard projection equipment have been designed, developed and contributed to the industry by practicing projectionists. Indeed, there are several manufacturers who never fail to consult projectionists on any improvement they are planning to make on their machines and some manufacturers have openly admitted their debt.

It is my hope that the Society will in time develop such a policy. The whole industry will benefit from it.

Will Dual Unionism Survive?

By FOLGER STUART

THERE are other industries besides motion pictures in which dual unionism has got a foothold. But whereas it is a recent development in the film industry other industries have had to cope with it for many years. It is gratifying to know however that nowhere have unofficial unions become strongly established and their existence has always been precarious and short-lived. If the lessons of the past are to be taken as an indication of the future, then dual unionism in the projection field will wane as rapidly as it waxed to its present position. As a matter of fact much of the alleged strength of these unrecognized "unions" is exaggerated. They live chiefly in the newspapers and in conversation. Except for several large cities they are practically unknown throughout the country.

They come to life and eke out their brief existences chiefly in days of economic depression. Very little is known of them in periods of prosperity. For the same reason they die off quickly as soon as economic well-being makes itself felt again. They are mushroom growths that cling feebly to loose soil and are ripped out with little exertion. Hysteria brings them to the fore; calmness shoves them aside.

Will Not Live Long

Their birth, full-grown, so to speak, is the cause of their rapid decline. They lack the firm foundation, the will to live, the accumulation of experience, the feeling of loyalty to their class that comes from long sacrifice and suffering in the attainment of an ideal. Laboring men who have never sensed their common cause with others who toil in the factories and shops and theatres, too, cannot be depended on to cling long to any association. They are not too individualistic, they are merely drifters, mentally and physically, and in the passage of their lives they will be found in many trades and many professions, gleaning no more than a moderate livelihood at any time.

Directly contrasted with this type is the union member who joined to reap the advantages which numbers and solidarity alone can give him. In payment for these advantages he is prepared to make many personal sacrifices. He gives willingly a portion of his pay to support the organization which works for his welfare. He is prepared to suffer with it in bad times because he expects to benefit by it in good. He is prepared to go long stretches without work if necessary. But above all else he has a strong feeling for official unionism. Some call it class consciousness. Whatever its name it is certainly an appreciation of his position in the economic system in which he lives and a readiness to wage a life-long fight to achieve and maintain better working conditions and better remuneration for his work—both for himself and for those who will follow after him.

It is a silly business at this time to offer an apology for unionism as we understand it today. Long before our times it came to be accepted as a fixture in the economic world. There are employers the world over who will employ only union labor. It is not an exaggeration to say that should unionism be dissolved overnight, industry would be in chaos in twenty-four hours.

That is true because competence is as much a requisite of union membership as any other qualification. I know of no A. F. of L. union for example that does not count among its members the most experienced and the keenest workers in its field. These members are not new to the organization. They have worked long in their professions and can be depended on to work efficiently and expeditiously. New members go through long apprenticeships before they are qualified for full membership and are sent out to do responsible work. The most outstanding examples of this are the typographical unions. They have their own schools where young men are trained carefully for the jobs in which they are ultimately to supplant their elders. As a result you will find many print shops which employ union labor and pay the union scale or even higher despite the fact that they do not carry the union label.

Conversely, unaffiliated unions spring up only in those trades where competence and skill is not necessary. While I have no record of any unofficial unions among teamsters or chauffeurs, it is easy to see that they would gravitate into such occupations first. Yet even here they are at a decided disadvantage in the minds of many employers. Men who belong to recognized organizations are responsible people. The organization assumes a responsibility for them, vouching for their character and honesty. Employers have a feeling of confidence in such employees.

Projection Needs Skill

Now in the projection field competence and skill are necessary to a very high degree. In addition the work requires men who have resourcfulness, initiative and a calmness in the face of danger. Such qualifications are imperative, for example, in case of fire. Again, reverting to the need for skill and competence, it needs those who have a thorough understanding of projection equipment because it is costly and delicate. Railroads entrust passenger trains only to engineers who have spent years in training in the service. That is why most of them are generally men around middle age or past. It is not the strength of the railroad unions alone that has made them so fixed in the railroading world. Imagine any railroad system entrusting its passengers to untrained men!

Projectionists, while they are in the projection room, have the fate of millions of people in their hands nightly. They are handling equipment that costs many thousands of dollars. A sudden breakdown, even without serious injury to audience or equipment, paralyzes the show and cuts out all revenue. That this fact is recognized is seen in the policy of all the big theatre circuits which employ only members of the regular A. F. of L. projection unions, because in these theatres skill and competence is at a premium. A projectionist who exhibits the slightest unfamiliarity with his work has short shrift in these big enterprises.

It is therefore a phenomenon of singular importance that the motion picture industry has offered a field of operation for these unofficial organizations. It can be explained of course by the times. In the first place almost all sections of the picture field have attracted people of all kinds because of the reputedly high salaries. Projection has been no exception, though any impartial and thorough nation-wide survey would reveal a general wage scale no higher than is in force in any other industry that demands skilled workers. In fact the wage scale as a whole is lower than it should be.

Strength in Unionism

It is an axiom of unionism that its life and strength depends on keeping the greatest portion of its membership working—and thereby content. Obviously, it must limit its size to the absorbing capacity of the industry in which it exists. To enlarge its membership to include all applicants would soon result in most of its members being unemployed and that way lies the breakdown of the organization. A union must refuse to take in more than it can reasonably keep employed, just as employers cannot employ more than they need to function efficiently and continue to thrive.

In good times those who have applied to projection unions for membership and have been turned away have generally found employment in other fields. But today with the hue and cry for more economy, salaries have borne the brunt of all economy moves until they have reached the level below which lies inefficiency and incompetence.

Theatre managers have taken advantage of the depression to insist on such low salaries as to make the employment of regular union men impossible. It is in such a situation that non-union men have found easy going at the moment.

But this situation cannot long survive. Dual unionism is doomed today as it always has been.

Future issues of the MOTION PICTURE PROJECTIONIST will carry a more detailed analysis of dual unionism.

Precise Nature of Optical Glass

By ALEX J. WEINSTEIN

> The author of this article is associated with the Fish-Schurman Corp. of New York, for many years importers of optical glass for many American industries. In popular language he gives a detailed explanation of the complicated processes involved in the manufacture of optical glass with particular reference to motion picture requirements. Projectionists to whom condensers, lenses and port-hole glass are familiar every-day objects will find Mr. Weinstein's article interesting and useful.

OF utmost importance in the design and manufacture of lenses and other optical elements with which the projectionist is primarily concerned, are the optical and physical properties of the glass used, and the degree of uniformity to which they are maintained.

Until the middle of the nineteenth century opticians worked under the enoromus handicap of using materials of little known properties and totally lacking in uniformity. It was not until the latter part of the century that Dr. Otto Schott and Professor Ernst Abbe began the work that led to a precise knowledge of the manufacture of optical glass on a large scale with a degree of uniformity and accuracy previously considered impossible. To these men and their associates at Jena, motion pictures owe an incalculable debt.

Of most interest to the projectionist is a discussion of the difficulties which are encountered in making and developing optical glass that would fit into his particular field. It was not very long ago when motion picture photography and projection was still in its infancy and the development of the industry was only able to take place with the co-operation of these pioneers in the manufacture of optical glass.

In no other industry has the development of optical glass and the optical sciences played so important a part. The workabality of optical glass combined with its high light transmitting qualities make it indispensable in present-day motion picture projection where lenses, condensers and reflectors must be of the highest quality glass possessing definite optical characteristics.

Now for a word about the manufacture of optical glass. It will first be necessary to distinguish between optical glass and ordinary glass. Ordinary glass such as glass used for bottles and decorative work has been known to the ancients for centuries and has always been manufactured in more or less large quantities. Optical glass, on the other hand, is a comparatively modern development to meet the demands for better photographic, projection, telescope or microscope lenses and other optical apparatus. At first sight optical glass may appear to be simply glass not greatly different from ordinary glass, but the differences between the two are fundamental and can best be appreciated and understood by an examination into the functions of optical glass, an integral part of a camera, projection machine or optical instrument.

A fundamental requisite for optical glass is homogeneity and light transmittivity and a uniform index of refraction. Even a slight departure from a high degree of uniformity in composition would not be tolerated because of the effect on the performance of a finished optical part.

The stress laid upon the importance of perfect homogeneity in optical glass will more easily be understood when one realizes that optical glass, which is used for lenses, must refract equally such rays as pass through every part of the glass substance. Compared with other types of glass, optical glass is a thing of extreme precision; the entire manufacturing process of optical glass has been developed with the object of attaining a highly homogeneous and precisely composed product. The mixing of the glass batch, the heating of the ingredients under controlled temperatures, the precision annealing which is so necessary to prevent strain and assure quality of projection condensing lenses, all require infinite patience, technical abilty and long years of experience.

First, the ingredients that go into the composition of the raw glass are selected under the most rigid inspection for purity, uniform compostion, particle size and quantity. The percentages and quantities of the ingredient to be used have all been determined by long years of experimentation. The materials are placed into a clay crucible which has undergone at least two years of ageing so that it will ably withstand the crucial test of long hours in the glass furnace under intense heat. After the batch has become molten another difficulty arises in stirring the contents of the crucible so that there will be an exact and even distribution of the entire contents of the crucible. This problem is of the greatest technical importance and, if not given the most accurate attention, will result in the entire crucible of glass being wasted. The crucible contents must be stirred with infinite care at so many strokes within a definite length of time. All of these factors have already been worked out by the research bureau of the factory.

On cooling to a dull red heat, the pot of molten glass becomes increasingly stiffer and with falling temperature acquires more and more the properties of a rigid solid. The rate of cooling is, however, not equal in all different parts of the pot and the rates of contraction are correspondingly different. As a result internal stress and strains are set up. The factors which enter into the problem of the cooling and annealing of a pot of optical glass are complete and each type of glass must undergo individual attention in the annealing process.

The glass is then cut into slabs approximately the size of the lens blank. Before putting the optical glass to work, it is then given the most rigid inspection for defects, such as striae and strain which is so important in the case of a blank to be made into a heat resisting condenser, so that the condenser would stand up under the most arduous service without cracking, from internal stress in the glass body. An optical heat-resisting condenser must under no circumstances be confused with an ordinary condenser which is made out of a glass that can only claim heat resistancy as a characteristic, but which has no optical properties whatsoever. The projectionist will understand quite well with his technical training that the quality of the lens does not depend upon its brightness of the polish. Superficial appearance is, in this case, of no importance and instead, emphasis must be laid upon the type of glass, annealing of the glass substance and precision of the lens curvature.

After undergoing precision grinding and polishing optical lenses are then inspected for focal length, accuracy of centering, and quality of image with respect to definition and distortion.

Only a few years back the optical glass manufacturer did not have the problems to confront him that are prevalent now in the manufacture of condensing lenses or photographic lenses. Operating conditions at that time were entirely different. The majority of theatres were built on a very much smaller scale and it was not necessary to throw a light beam for the seemingly unheard of distance of eight hundred to a thousand feet with a full condensation of light upon the screen as is the case in projecting on the stage or screen of a large modern motion picture theatre.

At no time in the history of glass making, did the need ever arise for the development of a glass which would stand up under heat intense enough to even melt metal. In the old days, a Mazda bulb or a gas flame was sufficient for ordinary projection purposes. The radical changes and improvements in equipment however, have been so extensive that, with the introduction of the carbon arc, a lamp is usually considered out of date if it draws less than 120 to 220 amperes.

It is common knowledge that a lens which is not of optical quality usually possesses a charactertistic green tinge which is extremely objectionable for projection purposes because of the impossibility in obtaining a pure white light beam. Some lens manufacturers overcome this defect by adding a chemical decolorizer to the glass batch which, until the condenser is used, will reduce the green color to some extent. This method is not tolerable from the projectionist's point of view because, as soon as the condensing lens is used

(*Continued on page* 26)

Answers to Questions on Patents

By RAY B. WHITMAN

Readers are urged to avail themselves of this free service for advice on the subjects of Patents, Trade Marks, Designs and Copyrights. .If a personal answer is desired, a stamp should be enclosed with the inquiry; otherwise the question and its answer will appear in this department in the first available issue. Address all questions to the Patent Editor in care of THE MOTION PICTURE PROJECTIONIST. *Write on one side of the paper only, giving full name and address and business connection. (Only initials will be published if requested.)*

Q. Does the granting of a patent to me give me the right to market my invention free of infringement of other patents?—J. M., Detroit.

A. No. A patent is merely a monopoly giving you the right to prevent others from making, using and selling the invention as specified in the claims of your patent, but it does not necessarily follow that there may not have been other patents previously issued which would be infringed by any use of your improvement patent.

Q. Can a mere idea be patented? —Louis Carl, Pittsburgh, Pa.

A. No. Patents only cover the means employed to effect results, and neither an idea nor a function, nor any other abstract thing, is patentable. Invention begins with an idea cal result such as a means or method of utilizing the idea in a practical way, and it is that which is the proper subject of a patent in our country.

Q. Is there such a thing as a basic patent?—L. T., Davenport, Iowa.

A. Yes. But they are few and far between, the vast majority of patents being mere improvement patents, or at best, semi-basic patents. True basic patents are such as the controlling patents which were taken out on the cotton gin, the reaper, the air brake, telegraph, telephone, aluminum production, the audion and the regenerative circuit for radio, the incandescent lamp, the induction motor, electric welding the phonograph the motion picture, the airplane, the halftone process, and a large number of labor saving devices, like the sewing machine, the typewriter, the cash register, casting type machines, glass making, and shoe machinery appliance.s. There are also fundamental patents on inventions relating to domestic appliances, such as the vacuum cleaner, the safety razor and also applances used in warfare, like the revolver and the machine gun. Of course, almost all of these inventions are so old that the patents have long since expired, and therefore, there are no longr basic patents protecting these invntions but merely less important patents covering improvements thereon.

Q. What is the best policy for any corporation to pursue regarding patents?—J. Mackay, Salt Lake City.

A. "To Live and Let Live," is a policy more agreeable to the masses, than the maintaining of a monopoly which the law may sanction—namely, the patent monopoly. To become known in the trade, therefore, as always getting out something new and better, and thoroughly protecting it by patent, and advising all competitors of such protection, and bragging about it in one's advertising to the trade, is a far better policy than that of litigation.

..*Q.* Is it very important to the strength of a mechanical patent to have it contain good drawings of the invention?—L. M., Dallas, Texas.

A. Yes; it is vitally important. The value of good patent drawings is seldom appreciated by inventors and others interested in patents. Nevertheless, it is a vital matter and in many cases the very strength of the patent depends upon the skill displayed in the preparation of accurate patent drawings.

At the present time since models are no longer required, it is especially important that the drawings fully illustrate the inventon and be so complete that a person who is skilled in the art to which the invention relates, could understand the purpose and operation of the invention, without referring to the specification, and the drawings moreover, if possible, be easily understood by those not conversant with the art; for in such case, capitalists and manufacturers can understand the invention by looking at the drawings, and it will be made easier for the inventor to exploit the sale of his rights.

A casual study through a number of patents as issued each week by the Patent Office shows that a large number of the drawings are not sufficiently clear to enable an average person, not skilled in the particular art, to understand them; and in fact, even for those familiar with the art, drawings are frequently difficult to understand, involving much study of the specification, and in lots of cases moreover, are actually inaccurate to a point where the validity of the patent itself is affected.

Good drawings facilitate the examination of the application in the Patent Office and doubtless, have a favorable effect on the Examiner resulting certainly in no less protection than would be possible with poorer drawings in the case, and probably in more.

If the drawings are well made to clearly illustrate the invention, it is not so important, although still highly desirable, for the specification to accurately and completely describe the invention, for the decisions are that a disclosure either in the drawings or specification, will support corrections to the case during its prosecution, or will permit of interpreting greater breadth into the claims after the patent has been issued, consistent with the disclosures.

Wherever there is doubt as to which particular part of a complete device represents the invention, the doubtful parts should be added to the drawing, and made a part of the disclosure, and claims to such parts also prepared and included in the case.

Q. Is there such a thing as contributory infringement of a patent by one who does not himself directly infringe?—K. R., Sioux City.

A. Yes, of course; and the fundamental rule underlying contributory infringement may be stated as follows: Infringement being a tort and in torts all participants being principals, action lies not only against him who has diverted another's business, but also against him who contributes to such diversion.

Films in Education

THAT motion pictures have definitely become recognized as an important factor in education is seen with the introduction of twenty films on the physical sciences as part of the freshman curricula at the University of Chicago.

According to Dr. Robert Maynard Hutchins, its 33-year-old president, several years were required to perfect this latst contribution to the progressive traditions of the university. Dr. Hutchins believes it to be the first organized attempt to ascertain the value of talking pictures to higher education. Far from being something in the nature of entertainment or as Dr. Hutchins puts it, "an attempt to jazz up education," the advantages that talking pictures will bring to serious study are already apparent.

Pictures taken of phenomena which cannot be seen by the naked eye can be shown simultanously to hundreds of students at present compelled to line up and take tedious turns at a microscope. A delicate, expensive experiment in electrostatics can be filmed once under ideal conditions with a verbal description by a well-known physicist. The life of a plant spanning six months will be shown in ten minutes to the accompaniment of a lecture by a leading authority on botany. The flow of protoplasm in plant and animal life, the excavations of Nineveh and Megiddo, the heartbeat of a dog, or the history of transportation will be demonstrated with the technique of a master teacher to large classrooms packed with students.

In the opinion of Dr. Hutchins, talking pictures are the educator's most adaptable tool. He expects that their use will be extended to every branch of study in the University of Chicago, and to many of the 2,200 other educational institutions using the university's system of instruction, supplementing rather than replacing existing agencies.

COMING

• • •

A New Book

TROUBLE
SHOOTING
in
SOUND
EQUIPMENT

• • •

By Lloyd Harding

• • •

COVERING
EVERY W. E.
AND R. C. A.
TYPE OF
EQUIPMENT

• • •

MANCALL PUBLISHING CORP.
7 WEST 44TH STREET
NEW YORK CITY

New Type of Circuit Control

A new type of lighting control that flashes, dims or brightens lamps with a wide variety of effects—and which requires neither moving parts nor electric contacts—has been produced in the Research Laboratory of the General Electric Company.

The light control, as well as many other effects, is obtained by combinations of saturable-core reactors, copper oxide rectifiers and resistance units, built up into non-linear circuits. These circuits have been produced, and their effects are being studied, by Dr. C. G. Suits.

Saturable-core reactors are essentially iron-core inductances so arranged that the inductance may be changed by saturation of the core material with direct current. One watt in the direct-current winding is sufficient to control 100 watts in the alternating-current circuit; the method of control is from 85 to 95 per cent efficient; and practically unity-power factor operation is provided. An important property of the saturable-core reactor is a time delay factor that is required for substantially full-load voltage to appear after the direct current is applied. This time delay, which may be varied in duration by use of a variety of circuits, provides the sequence operation which is independent of the thermal characteristics of the incandescent lamps. Feed-back circutis are employed to cause sequences to repeat, or commutate. The load reacotrs are also the control reactors; auxiliary control means are not required. The circuits are entirely free from radio interference, and are silent in operation.

Among the applications for such types of non-linear circuits there have been suggested the control of illuminated fountains, airport border-light flashing, architectural and colorama lighting control, and similar uses. Still other types of non-linear circuits have been suggested for traffic and airport beacons, electric clocks, induction heating, electric music, and high-frequency sirens.

Other Types of Circuits

Recent experiments in the laboratory have brought to light non-linear circuits which are oscillators or generators of alternating currents, in such respects functioning like vacuum tubes. One circuit produces such slow oscillations that an incandescent lamp is turned on and off if placed in the circuit, several times per second or as slowly as once in thirty seconds, according to the arrangement of the cricuit. One such oscillator has blinked a light on and off silently, without radio interference, and without wearing parts, approximately 100,000,000 times in the past two years while on life test in the laboratory. There is nothing to wear out.

Another oscillator produces relatively high-frequency alternating current. It was known for some time that high frequencies could be produced in transformers under certain conditions, but these frequencies are always multiplied or integral fractions of the frequncy eof the power supply. The new oscillator will produce any frequency in its range of usefulness; vibrations of 5,000 cycles per second already have been observed audibly in the laboratory.

Still another application of non-linear circuits has been in resonance relays. Such relay circuits, which function because of "voltage resonance" and "current resonance" principles, are so sensitive that a voltage change of as little as 1/100th of one per cent will cause a current change of 100 per cent. Relays of this type are adjusted by changing electric constants rather than mechanical constants, and are therefore practically free from the effects of wear, friction, dirt, and extremes of temperature; the burden of accuracy is placed on a circuit, where accuracy may be obtained economically with perfect reproducibility.

OPTICAL GLASS

(*Continued from Page* 24)

for the first time, the glass will immediately discolor and blacken.

Another instance where optical glass has played an important part in assisting the projectionist to maintain sound projection was in offering a solution to the problem of excluding disturbing operating noises from issuing through the auditorium of the theatre. In theatres today first consideration is that of proper acoustics. It is usually the case, however, that those problems which are simplest usually receive the least, when they deserve the most, consideration. After the theatre has been built it is found that the operating noises from the projection room filter out and escape into the auditorium and that the audibility and comfort of the audience are seriously disturbed.

It was necessary therefore that optical glass be put to a new use and that a glass should be developed which would satisfy the following exacting requirements:

First the glass would necessarily have to be entirely colorless so that in projecting through a plate of this glass, there would be absolutely no loss of light. Then the glass would necessarily have to possess the same dispersion qualities as the projector lens so that there would be no undue distortion of the projected image. Every projectionist will realize how immensely important it is to obtain the greatest amount of light on the screen. It would also be necessary that the glass should be of pure optical quality entirely free from imperfections that would distort an image to be projected through it. Most important, however, was the requirement that the glass be free from striae of a constant optical index possessing a uniform degree of dispersion so that there will be absolute homogeneity throughout the entire body.

Another factor that was given consideration was that the glass would have to be ground and polished so that surfaces were entirely plan-parallel in order that the projected image would not undergo any distortion even to the slightest degree.

Good Housekeeping Eliminates Fire Hazards

By R. B. DICKSON*

NATIONAL Fire Prevention Week has just been observed and it is of particular interest to projectionists and theatre managers to review at this time the factors which they have provided in the projection room and in other parts of the theatre for the safety of the projection crew and the patrons.

Uncontrolled fire, under any circumstances, is to be dreaded. Particular emphasis must be placed on protection against this danger in places of public gathering. Theatre men must guard against fire—and the resulting panic—and, of course, the stopping of the show and perhaps the loss of the whole theatre.

Some Sad Lessons

We have had our sad lessons. The Iroquois Theatre fire in Chicago in which hundreds of lives were lost, is still vivid in the minds of many people. Following that was the fire in a motion picture house at Boyertown, Pa., where 169 persons were killed, and the theatre fire at Calumet, Mich., in which 72 people lost their lives. More recently was the disaster at Paisley, Scotland, with an appalling loss of life.. The manager of this house was tried by the Scottish Courts for negligence. The Pathe Studio fire in New ork, which occurred last winter appears to have been preventable. The ten lives lost here would have been saved if some simple precautions had been followed. In March of this year a projectionist at the Bijou Theatre lost his life through somebodys' carelessness in handling film. These examples should be suffcient to convince every theatre owner of the need of adopting thorough and sensible fire protection methods.

The modern theatre is designed to insure safety and ease of entrance and egress for its patrons. It is or should be sprinklered and provided with stand pipes and hose lines. Suitable hand extinguishers should be placed at frequent intervals, and care taken to see that these are ready for any emergency. The value of portable fire protection cannot be overestimated. Fire, extinguished at the beginning cannot spread to cause death or damage. All fires are small fires first, and usually can be readily extinguished, if suitable first aid appliances are available. The vital point is to have extinguishers and other equipment ready when needed.

Good Housekeeping

Careful attention should be paid the housekeeping feature of the theatre. Untidiness in any form leads to carelessness, and this brings the danger of accidents and fire. Managers should appoint one man to inspect and maintain their fire fighting equipment. This man should be held responsible for its condition and impressed with the importance of having every piece in working order, and available for emergencies. Many of the chain theatres maintain such a service, and have periodical inspections of their equipment.

Houses showing pictures only, have fixed hazard points which can be easily covered. Sound attachments bring few complications involving fire risks, and they can be readily foreseen. Houses with combination picture and vaudeville or specialty acts have the added danger brought through the human element. Back stage protection in the vaudeville house must have the most careful attention. There is the ever-present danger from accident of some kind from careless smokers—either performers or visitors, from electrical wiring, or inflamable materials carried with an act.

Types of Extinguishers

Extinguishers can be divided into three general classes. Briefly these are as follows:

First: The quenching or cooling type. This type is designed to protect free burning materials, such as wood, fabrics, rubbish, etc. Extinguishers of this class include the ordinary chemical (soda and acid or tip-over type) hose lines, water pails, pump tanks and devices using water as the principle extinguishing agent. They extinguish a fire by cooling the burning materials below the kindling point.

Chemical extinguishers of the soda and acid type mentioned in the foregoing paragraph should be installed throughout the theatre at points readily accessible. Not less than 2 or 2½ gallon hand chemical extinguishers should be located at each side of the stage. The approximate maximum area that one extinguisher is designed to protect is 2,500 square feet.

Second: The blanketing type. Extinguishers such as foam type, Pyrene or Carbon Tetrachloride and Carbon Dioxide. Extinguishers of this class are designed to handle fires in highly flammable material, and are particularly effective on oils, greases, gasoline, paints and similar materials not easily extinguished by water.

If the theatre is heated by oil burners at least one of the 2½ gallon foam type extinguishers should be within easy reach near the oil burner, and accessible from a stairway. At least one of the Carbon Tetrachloride type extinguishers should be provided for the switch board.

Third: Non-conductor type. These are such as the Carbon Tetrachloride and Carbon Dioxide. These extinguishers can be used safely an electrical equipment, such as motors, genrators ande "live" wires.

Carbon Tetrachloride or Carbon Dioxide extinguishers should be placed in locations convenient to any risks of this sort in the theatre.

Soda and acid or foam extinguishers or any extinguishing device containing water should *not* be used on electrical equipment. Danger to the operator plus possibility of damage to the equipment make it imperative to use a non-conductor type.

All of these types are made in different sizes and in several different forms. The theatre owner should select equipment made by reliable manufacturers, and in every case should endeavor to purchase the best of equipment, planning to get quality rather than buying on price alone.

Soda and acid or foam type extinguishers should be recharged annually and the date charge marked on the tag attached to the extinguishers. If an extinguisher is used it should be recharged immediately.

Necessary Precautions

The following simple precautions, none of which entail any great expense, should be taken:

Each projector room should be equipped with two fire extinguishers not smaller than 1 quart capacity.

Immediately outside of each projector room there should be another such extinguisher.

Metal cans with heavy closing covers should be provided in the projection room for holding waste material or film cuttings. These should be emptied daily.

Hot carbons or any discarded carbons should be placed in special metal containers.

The projector rooms should be kept clean at all times, and smoking or the use of matches or open lights should be prohibited.

The projector room should be equipped with approved type of enclosed film re-winder, unless a separate fireproof room is provided for re-winding.

All projectors and spot lights should be securely fastened to the floor. Projectors should of course be equipped with automatic fire shutters or aprons.

Legal Requirements

The precautions suggested are the simplest, and in fact are insisted upon by most of the insurance companies carrying theatre insurance.

Recently legislative action with a view to protecting the public against fire and panic has been taken by some of the states and municipalities. For example, the state of Pennsylvania has recently put into effect comprehensive regulations designed to protect theatres under their jurisdiction from fire. More recently some of the larger municipalities have revised the codes and methods of inspection and are insisting on strict compliance with their regulations. The city of Syracuse, N. Y., for example, has recently adopted a rigid theatre code, which if enforced will do much to prevent theatre fires in that state.

The fire departments of the first class municipalties today try to aid in the prevention of fire through periodical inspections made by firemen trained for this purpose.

---

* *Pyrene Mfg. Co.*

Power Conversion

By ENGINEERING DEPARTMENT, ELECTRICAL SPECIALTY COMPANY

THERE are a number of different kinds of apparatus installed in a modern theatre which require electrical current of characteristics not obtainable from the power supply lines.

Among these, the exciter lamps, filaments of the vacuum tubes, and field circuits of the loud speakers, have been supplied by storage batteries in most installations in the past. Storage batteries were first used because it was thought that other power supply apparatus would cause background noise. The storage batteries answered the purpose, and of course did not produce any background noise in the equipment. However, they require a considerable amount of attention as they must be kept charged, and their life is comparatively short, it being necessary to replace them in about two years after installation.

Since the first installations were made, there have been many improvements in the design of motor generator equipment and motor generators are now available which will operate the sound equipment in theatres without noticeably increasing the noise level. The cost of the motor generator and associated equipment is only a little more than the cost of a replacement storage battery, and when once installed the motor generator requires almost no attention. The bearings have to be lubricated about once a month, or less frequently, and it is usually necessary to replace the generator brushes about as often as the entire storage battery equipment requires replacing. It does not become necessary to replace a complete motor generator set, and with ordinary care only minor repairs ever have to be made.

Filtering

If motor-generators of suitable design are used, no filters are required in connection with the field circuits of the loud speakers. The speaker field supply may be taken directly from the motor-generator set. It is customary to install a small enclosed panel box, arranged for conduit wiring, containing an ammeter and field rheostat for adjusting the generator current. The amperage in the speaker field circuit may therefore be readily adjusted to the desired amount. This panel box can, of course, be mounted in a convenient location in the projection room. The motor generator is ordinarily installed in the compartment previously used for the storage batteries. It, of course, occupies considerably less space.

The supply to the exciter lamps should usually be filtered by the use of a single electrolytic condenser of high capacity connected across the generator terminals. No other filtering is required for satisfactory results.

The supply to the filaments of the amplifier tubes in the photo-electric cell amplifier requires a little more careful filtering, as these circuits are very sensitive. Filters have been designed which are inexpensive and compact. The filament supply of the Main amplifier tubes, when direct current is used, does not require as careful filtering as that of the photo-electric cell amplifier.

A single motor generator may be used for furnishing power to the speaker fields, exciter lamps, and all amplifier filaments. In that case, it is usually convenient to install a small box near the motor generator, containing the electrolytic condenser connected across the generator terminals, and also a meter and field rheostat. The supply for the speaker field is taken directly from this box as is that for the exciter lamp and photo-electric cell amplifier and a separate box with filter is installed near the projection machine. If the wiring is such that the exciter lamp and photo-electric cell amplifier filament supplies are separated, it is advisable to install a filter for each. The two filters may be mounted in a convenient box installed near the projector. A small separate box may then be installed near the main amplifier containing the filter for that circuit. Separating the filters into several units, as indicated, enables the use of comparatively small boxes. A large single box for all the filters is quite bulky and it is sometimes difficult to find space for it. The boxes should all be totally enclosed, with hinged covers and knockouts for conduit connection.

Converted Power Supply

A.C. is required for the operation of amplifiers of modern design but in many theatres there is only a direct current supply. A converter or motor generator set is then installed for changing the direct current supply into alternating current. If amplifiers only are to be operated from the motor generator or converter, a machine of the converter type is entirely satisfactory when furnished with a suitable filter. If the projectors are fitted with synchronous motors, or other special constant-speed motors, requiring alternating current for their operation, the rotary converter will not answer the purpose, as there will be too much drop in voltage when the motors are started up, and too much difference in voltage when two motors are in operation, as compared with one motor. In that case it is advisable to use a motor generator set with compound wound generator, the series field being connected in series with the motor line. In installations where the direct current primary voltage is subject to wide and sudden variations, the motor generator set should be provided with an automatic speed regulator to maintain constant speed of the set. If the generator is self-excited, the output voltage and frequency will then be entirely independent of variations in the primary voltage.

The arc lamps, spot lights, etc., used in motion picture projectors are much more efficient when supplied with direct current. It is usually customary, therefore, to install motor generator sets to operate from the alternating current supply lines, and to provide direct current of about 70 to 80 volts for the arc lamps.

These motor generators are subjected to sudden changes in load and they must be very carefully designed to deliver steady voltage under such conditions. The generators must operate under heavy overload conditions without sparking at the commutators, and without allowing the voltage to drop to any great extent.

In order to accomplish this, generators of liberal rating must be supplied and they must be furnished with commutating poles to insure good commutation and lack of sparking under all conditions.

Polyphase A.C. motors are usually used on account of their small size and machines of completely protected construction arranged for conduit connection are required.

Location and Maintenance

It is important to install motor generator equipment of any kind in accessible locations where it may be readily inspected and oiled.

The motor-generator equipment should be inspected at regular intervals and lubrication of bearings taken care of at the same time. The commutators and brushes should be kept clean, and free from grit and dirt, and brushes should make proper contact with the commutators. Care should be taken not to use too much oil or grease in the bearings. Much more trouble results from the use of too much lubricant than from the use of too little. If oil is added in excess, it will overflow from the bearings, and if it gets on the commutator or brushes, it prevents good electrical contact, and causes fluctuations in voltage, or even failure in voltage. If too much grease is forced into the bearings of ball bearing machine, it may be forced past the bearing, and into the machine itself and eventually attack the insulation and cause serious trouble.

RCA Sues Powers

RCA Photophone and the General Electric Company are bringing suit for patent infringement against the Powers Cinephone Equipment Company of New York, P. A. Powers, an individual, Walt Disney Film Recording Company, Limited, Walt Disney Productions, Limited, and Walt Disney, an individual, alleging infringement of six patents owned and controlled by General Electric and RCA Photophone.

The patents claimed to be infringed are Fritts patent number 1203190; Fritts patent number 213614; Langmuir patent number 1223496; Langmuir patent number 1213094; Moore patent number 1316967; and Hoxie patent number 1756863.

IN ROCKEFELLER CENTER

(*Continued from page* 13)

Amplifiers

B. A duplicate channel eighty-watt main amplifier, Type PA-88 and Type PA-87 is to be furnished with this system. The voltage and power amplifier units are the same as those used on the sound reinforcing system (No. 1). These racks are located in the rear wall of the projection room, as shown on Figure 1. These racks are particularly adapted for flush mounting in the wall because all servicing is done from the front.

The Type PA-88 Amplifier includes necessary terminal strips, main line power switch, a Type PB-23 voltage amplifier unit, two Type PB-45 power amplifier units (40 watts each), a jack panel, a Type PB-63 dual channel switching panel, a type PB-64 projector changeover panel and a Type PK-21 loudspeaker field supply panel. The jack panel is to be used for "patching." By this means the main sound projection system may be interconnected with any of the other systems. The rear stage projection system is terminated at this panel and may be connected to the main sound projection system by the use of patching cords. For normal operation, no cords are required. The dual channel switching panel includes a switch with a knob mounted on it for switching from one amplifier channel to the other. The projector changeover panel includes a number of relays and pilot lamps to connect the output of any of the four projectors to the input of the correct amplifier channel. The loudspeaker field supply panel is of sufficient size to produce 0.8 amperes at 100 volts.

The Type PA-87 amplifier includes necessary terminal strips, main line power switch, a Type PB-23 voltage amplifier unit, two type PB-45 power amplifier panels (40 watts each), a Type PL-21 loudspeaker field supply panel, and a Type BB-51 tube testing panel. The tube testing panel is the same in design and purpose as that supplied with the sound reinforcing system.

C. Located alongside the duplicate amplifier channels a Type PB-65 power supply rack is to be located. This rack includes four Type PK-17 exciter lamp panels and a Type PA-80 monitoring amplifier unit. Each panel delivers 5.0 amperes at 10.0 volts. One exciter lamp panel is supplied for each soundhead attachment. The monitoring amplifier unit is similar to the one described in the sound reinforcing system and operates the monitor loudspeaker in the projection room.

D. Four fader and volume control stations are to be furnished for wall mounting, one in front of each projector, for fading the amplifier input to the proper soundhead attachment and for controlling the volume of sound emitted by the loudspeaker. A remote volume control indicator consisting of twenty indicator lamps which indicate the amplifier volume control setting is to be furnished for wall mounting in the projection room. Five remote volume key control stations for mounting at various points in the auditorium are to be furnished.

E. The stage loudspeaker equipment to be used with this system consists of three Modell 4PL35C1 loud-

SUN-ARC CARBONS

PERFECT PROJECTION

"Best by Test"

BIG SAVING—COMPLETE SATISFACTION

BETTER LIGHT—SLOWER BURNING

CARBON SAVERS (Patent pending) free of charge
2 Savers for each Theatre. Burn Hilow and High Intensity down to 2 inches and less.

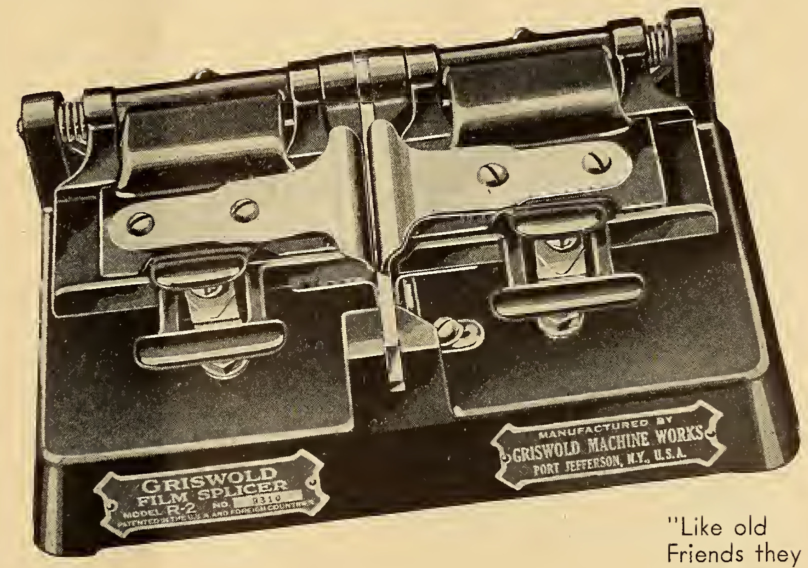
CARBONS FURNISHED READY FOR USE WITH THE SAVER. No inconvenience whatsoever for the operator.

HIGH INTENSITY CARBONS 13.6 are furnished 22 inches long.

Hi-Low Carbons (for 60-85 amps.) are precrated.

SAMPLES ON REQUEST

CARBON PRODUCTS, INC.
324 West 42nd Street New York City

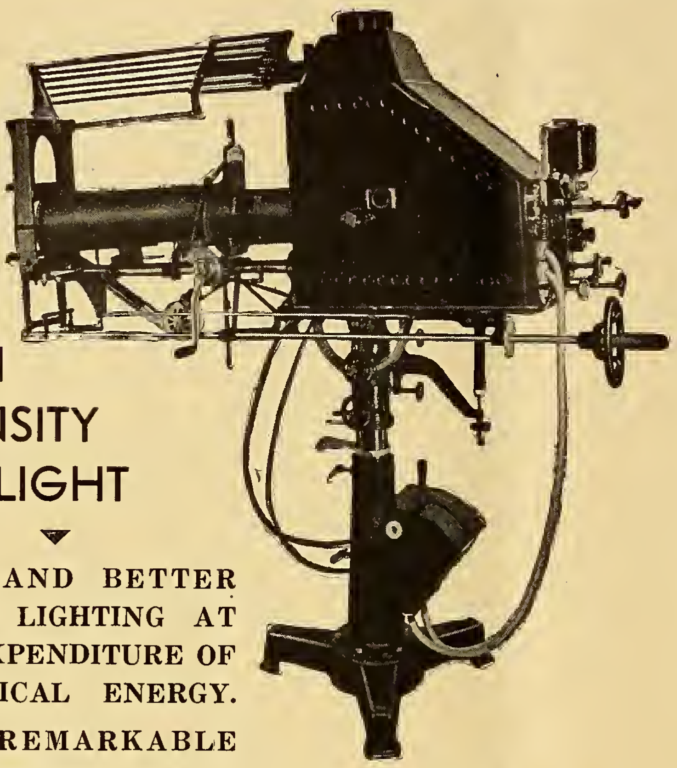


"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS
Port Jefferson, Long Island New York



HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, INC.
24 Van Dam Street New York, N. Y.

F. H. RICHARDSON'S HANDBOOK OF PROJECTION
5TH EDITION
The Blue Book of Projection
SOUND RECORDING REPRODUCTION AND PROJECTION
A Chalmers Publication

PROJECTION
As You Must Know It

This 5th edition HANDBOOK OF PROJECTION by F. H. Richardson is known the country over. It has been the means of making thousands of projectionists masters of their profession. Remember, Richardson gave the "operators" of 1910 the first projection manual ever written.

Now 3 Volumes

Over 1,400 pages of the most vital kind of information. More than 400 illustrations. Each volume carries the special Richardson question and answer index—the greatest feature any projectionist could wish to have.

If your future is linked with projection make it brighter and securer by owning and studying this finest of projection libraries.

The complete set of three volumes mailed to your door upon receipt of check or money order for $10.25.

Special sales representatives appointed by the Chalmers Publishing Company, publishers of the Handbook on Projection. - - - -

MANCALL PUBLISHING CORP.
7 West 44th Street New York City

speakers (10 foot baffle) and three Model 4PL35A1 loudspeakers (60 inch baffles). These loudspeakers are similar to those supplied with the sound reinforcing system and illustrated by Figure 8. A Model 4PL35B1 loudspeaker (37-inch baffle) with metal frame and mesh covering is to be mounted in the rear wall of the projection room for monitoring purposes.

This sound system comprises the latest and most modern sound reproducing equipment available for theatres. It is all A.C. operated, simple in design, compact for easy installation, easy to operate, and requires a low maintenance cost. The over-all characteristic of the system is such as to provide for faithful reproduction of all the audible frequencies from 50 to 10,000 cycles. A curve indicating this response is shown in Figure 13.

Rear Stage Projection System

This system is to be used for the projection of sound motion pictures from the rear of the stage to be used as background and for effects in conjunction with the stage presentations. It is all located in the rear stage projection room.

A. Two Type PS-20 Simplex soundhead attachments for mounting on Chicago cinema bases with super simplex mechanism are to be furnished with this system. These attachments are the same as those supplied with the main sound projection system.

B. A Type PB-65 amplifier unit as illustrated in Figure 14 consists of necessary terminal strips, a main line power switch, a Type PB-23 Voltage amplifier unit, a Type PB-74 projector changeover panel and a Type PK-17 exciter lamp panel. This unit is designed to be connected to the input of the main amplifier of the main sound projection system. The units are similar to those furnished with the main sound projection system, except that the projector changeover panel provides for only two projectors.

C. A Type PB-36 film phonograph will be furnished with this system. This unit is to be used for reproduction of a film record type of recording either alone or in conjunction with a picture on a separate film.

D. A Type PA-79 phototube amplifier is to be furnished for operation with the film phonograph to feed directly into the input of the main amplifier of the main sound projection system. The amplifier is mounted on the table of the film phonograph.

E. Two projector changeover switches are to be furnished, one mounted in front of each projector for operating the projector changeover panel.

F. A Model AF6179 loudspeaker employing a magnetic speaker unit on a flat baffle is used for monitoring purposes.

Preview Projection System

Two preview rooms located on the studio floor are to be equipped with sound projection systems. These systems are similar in general design to those furnished with the main sound projection system except that they have a smaller power output.

The Soundhead attachments are exactly similar to those supplied with the main and rear stage projection systems.

The amplifier equipment is likewise similar, consisting of a Type PB-23 voltage amplifier unit and a Type PB-24 (10-watt) power amplifier unit, together with a Type PK-17 exciter lamp supply panel and a Type PK-15 loudspeaker field supply panel. A remote volume control equipment is also included with this amplifier.

A Standard Type PL-64 monitering loudspeaker and a Model 4 PL35A1 (37-inch baffle) stage loudspeaker is supplied. A mounting frame for the stage loudspeaker has been included.

A desk mounting volume control, and fader and volume control switches for installation at each propjector are supplied.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of

MOTION PICTURE PROJECTIONIST,

published Monthly at New York, N. Y., for October 1, 1932,

STATE OF NEW YORK)
COUNTY OF NEW YORK (

Before me, a notary public, in and for the State and county aforesaid, personally appeared Boone Mancall, who having been duly sworn according to law, deposes and says that he is the Publisher of MOTION PICTURE PROJECTIONIST, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and regulations, printed on the reverse of this form, to wit:

1. That the names and address of the publisher, editor, managing editor and business manager are: Publisher, Mancall Publishing Corp., 7 West 44th St., New York City; Editor, Cecil Fowler, 7 West 44th St., New York City; Managing Editor, none. Business Manager, Boone Mancall, 7 West 44th St., New York City.

2. That the owners are Mancall Publishing Corporation, 7 West 44th St., New York City; Olga Mancall, 323 West 90th St., New York City; Boone Mancall, 7 West 44th St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is . . . (This information is required from daily publications only.)

BOONE MANCALL,
Publisher.

Sworn to and subscribed before me this 3rd day of October, 1932.

T. S. SIMPSON,
Commissioner of Deeds.

[Seal] (My commission expires January 19, 1934.)

Don't Overload Your Equipment

The case has recently come to our notice of a projectionist who called in an expert on sound to discover why it had lately become necessary to work the fader part of his equipment higher than hitherto. Our friend feared this to be a fairly unmistakable indication that his amplifier needed extensive overhauling. Examination of the latter, however, showed both it and its tubes to be in perfect condition.

But as the service man continued his inspection, he noticed that the exciter lamp was being burned at an amperage far below its specified rating. The projectionist admitted that this was being done purposely with a view to prolonging the lives of the exciter lamp and the photoelectric cell.

While most projectionists are well informed in this particular regard, we take the opportunity to remind them that today all equipment is designed to produce definite results for certain specified ratings. Each electrical unit in a sound projection system should be worked within the limits of its speified rating. If observance of this is not productive of the best results, it is an indication that one of the components does not fit the equipment or that there is something basically wrong with the installation.

In a smoothly working installation each unit works in predetermined relationship with the one dependent on it.

Adolph Lomb Dies

Adolph Lomb, vice-president of the Bausch & Lomb Optical Company, died at his home in Pittsford, N. Y., on Sept. 30, after a brief illness. He was 66 years old.

Mr. Lomb, the eldest son of Capt. Henry Lomb, co-founder of the Bausch & Lomb Optical Co., had been connected with the optical institution established by his father and John Jacob Bausch for 53 years. He entered the company when a young lad of fourteen, leaving temporarily to continue his university studies.

Besides being an executive of the Bausch & Lomb Company, Mr. Lomb was identified with a number of scientific and patriotic societies, chief among which was the Optical Society of America.

Mr. Lomb, who was born in Rochester in 1866, was a graduate of the University of Rochester, Class of 1892, and had also taken advanced work at the Massachusetts Institute of Technology and the University of Berlin Germany.

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

IT is no exaggeration to say that our rheostat is internationally famous.

Four out of every five theatres in this country use **Hoffman-Soons Rheostats exclusively.**

A first class product, backed by reputation and guarantee. It always leads the field.

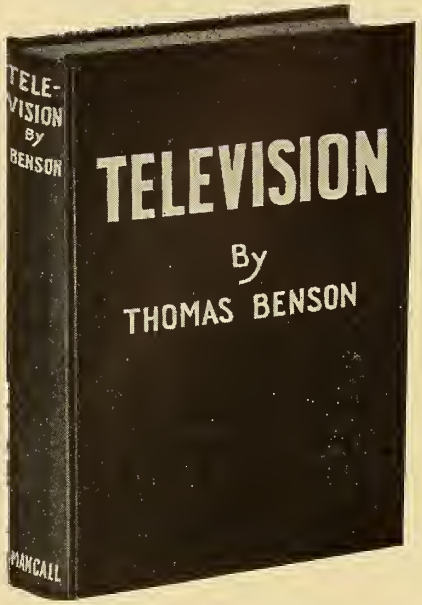
Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

The Only Union Made Rheostat

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Speecialists

RHEOSTATS

BE PREPARED!



TELEVISION
FOR THE
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today.

NOW
$1.00

FINAL EDITION
Only Few Copies Left
ORDER IT TODAY

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th St., New York City

Enclosed find money order for $1. Please send me Benson's Television.

Name..
Address..
City and State..
Theatre..

Design of New Simplex—Acme

(*Continued from page* 10)

In view of the importance of the intermittent movement, some additional explanation and working directions should prove interesting to all projectionists.

How to Remove Intermittent

To remove the intermittent movement of the Simplex-Acme Projector it is first necessary to remove the complete film trap and lens mount assembly as follows: First remove threading lamp shield by pulling it towards you. Next remove light shield between shutter guard and film trap. This may be removed by first removing the three knurled screws attaching it to shutter housing. Next remove focusing knob by removing screw and lock washer attaching it to vertical shaft just beneath the inside top of mechanism. Then remove four attaching screws and lock washers from casting supporting vertical focusing rod. Next remove two attaching screws and lock washers from lens bracket directly beneath the upper pad roller thumb piece, one above and one below the lens mount. Open gate—the entire unit may now be carefully removed from the mechanism, taking care not to damage intermittent sprocket with stripper plate. This assmbly is doweled to the main frame and extra care should be exercised in removing and replacing it. After removing this unit it will be obviously simple to remove and replace it. After replacing any part on this assembly, carefully replace the entire unit and attach in the reverse order that followed in removing, being careful to line up accurately the intermittent stripper plate as close to sprocket as possible without touching.

The intermittent movement may now be readily removed as follows: With two thin open end wrenches remove the two end play lock nuts and washers from flywheel shaft on non-operating side of projector. Remove retaining screw from hub of flywheel. Gently pull flywheel off cam shaft. Carefully remove cam shaft driving gear. Now return to operating side of projector and remove the two retaining plates, one above and one below the intermittent movement housing. The intermittent movement assembly complete may now be carefully pulled towards you.

The only part which may be readily replaced on this assmbly without the proper assembly equipment and experience is the intermittent sprocket, and for this reason no instructions are given to remove or replace any other part of this assembly. If for any remote reason the internal mechanism (star or cam and their respective shafts) should need replacing, the unit should be returned to the factory or an authorized service station for this purpose. It is anticipated, however, that these parts as originally assembled will give service for a great length of time before replacements become necessary.

To replace intrmittent movement complete, it should be reassembled to the mechanism following the reverse order of procedure to that set forth in the directions for removing intermittent movement. Caution: If difficulty is experienced in inserting intermittent casing into main frame, it may be readily attached by rocking the framing device back and forth gently until it finds its proper position in the oscillating frame. Use no undue force in replacing this assembly.

Resetting the Shutter

When the intermittent movement is removed from the mechanism the synchronism between it and the revolving shutter is temporarily lost and the shutter must be reset while reassembling the intermittent movement to the mechanism.

It will never be necessary to set revolving shutter except when the intermittent movement setting has been disturbed or the movement removed from the equipment. To reset, proceed as follows: Turn the intermittent flywheel shaft by hand until the intermittent sprocket just begins to move in the direction it normally runs. The revolving shutter is composed of two fixed and two movable blades, the latter acting as a fire shutter when the apparatus is stationary. Set the shutter timing adjustment knob so that the shutter adjusting carriage is in its central position. (This carriage will be seen to float back and forth on the non-operating side of the projector when turning the adjusting knob.) With the middle finger of left hand, bring one of the fixed shutter blades down in the direction in which it runs until it just covers the round opening to the rear of the aperture plate in the shutter guard. Place intermittent driving gear over flywheel shaft. Insert a screw driver in the slot on end of flywheel shaft to keep shaft from turning. Gently turn intermittent driving gear into mesh with gear on shutter shaft, selecting the gear tooth which will line up the hole in the gear with the hole in the flywheel shaft without turning the flywheel shaft or shutter shaft. Replace flywheel, lining hole in flywheel hub up with the hole in the gear and flywheel shaft. Then insert flywheel retaining screw with lock washer originally removed. Do not tighten at this moment. Replace washer and two lock nuts originally removed, tightening nut nearest flywheel just enough to remove all end play without bind in flywheel shaft. Hold the nut nearest flywheel from turning and lock the second nut tightly against it. Solidly tighten retaining screw in flywheel hub.

Within the last year International Projector Corporation has added many new features to its Acme machine, making it suitable for use in theatres of medium size. At first it had been designed as a semi-portable machine with a view to its use commercially and in schools, but it proved itself capable of theatre projection and emphasis is being placed in that direction now.

Falge on Screens

(*Continued from page 9*)

only general method in use today is to pass the sound through openings in the screen.

The opening in the screen may be due to the porosity of the material whether coated or uncoated or to openings cut into a surface in some manner. The openings should be as small and as few as possible. The minimum size of the opening from the sound standpoint is dependent upon the thickness of the material. In general, in a series with regular openings the diameter of the opening should be three or four times the thickness of the material. Screen thickness should be a minimum value, consistent with proper light reflection.

It is obvious, of course, that the larger openings the more apparent the spot will be to the near seats so that the holes should be small while still providing for satisfactory sound.

Screens may be carefully tested in a laboratory by measuring the volume of sound with accurate sound measuring equipment. A test is first made with the screen in place before the speaker and then with it removed. The test should cover the full range of frequencies found in the sound reproducing equipment, about 150 to 6000, although these tests may be somewhat inaccurate due to test conditions, the losses may be accurately gauged. The balance must then be taken between the harm to the sound and to light and the best condition established. The larger sound equipment manufacturers have established a test basis for approval of screens to be used with their equipments.

Screen Characteristics

There are many factors which contribute to the value of a screen, any one of which may seriously affect its performance. While it is not possible to have every one of these perfect, each one should be as near that as possible, and where two factors are at odds a satisfactory compromise must be made.

Of course we are most concerned with the picture that is sent to the eyes of the patron in the theatre. This must be modified for sound and the openings detract from the light qualities however it is only necessary that sufficient open space be provided so that sound is not hindered as previously described. The light reflection qualities of the screen however, act to make the picture.

Given satisfactory sound, as much light as possible should be reflected from the screen. This is its efficiency. We are perhaps even more concerned, however, with its distribution of light, as it is easy to conceive of a screen (a mirror for instance) set at such an angle that not one person in an auditorium would receive a satisfactory picture. Yet a mirror is highly efficient, actually about 90%. This latter point is the reason for different types of screens. In screens of the same type, however, other characteristics being equal, the screen with the highest efficiency is, of course, the best.

A fallacy, however, is to select a screen because it has a high initial efficiency. It is the efficiency through life that is most necessary and this depends on the amount of discoloration and the collection of dirt on the surface; the latter, however, is usually caused more by neglect or poor theatre conditions than by the nature of the screen surface.

There are many kinds of screens but all come within three general classifications. No one screen type is best suited for all houses. Screens should therefore, be selected to suit a particular house as they may vary in width from 20 to 120 feet or more, and in length from 50 to 150 feet. They may have no balcony or they may have three. The angle of projection may be 0 or it may be 35°, and the screen may be form 10 to 30 feet from the front row of seats.

The factors therefore to consider in selecting a screen are:

1. Adaptability to the particular theatre.
2. Reflective efficiency, initial and sustained.
3. Sound characteristics.
4. Durability.
5. Uniformity.
6. Fireproofing.
8. Color.
7. Illusion of depth.
9. Adaptability to color.

A discussion of each of these factors will allow us to estimate their relative value.

1. Adaptability to the particular theatre.

Because of the wide variation in dimensions and seating of theatres, it is logical to expect that a different kind of screen may be made for each. This is impractical, but there are certain different kinds of screens which may satisfy the needs of various classes of theatres. If we bear in mind that it is the patrons to whom we redirect the light it will help in understanding the screen problem and its importance.

All screens fit into three general classifications, depending on the manner in which they concentrate and redirect light. They are:

a. Diffusive or mat.
b. Directive or beaded.
c. Reflective or metallic.

Practically all screens of these types are now made with openings for the passage of sound.

a. Diffusive Screens·

Any surface which breaks up the rays of light into many small rays may be called a diffusive screen, though only those materials which redirect a considerable amount of light, thus being quite efficient, are suitable. We may, therefore, think of any white surface as a potential diffusing screen. Materials which have proven satisfactory are untreated fabrics cellulose coated fabrics, rubberized fabrics, fabrics with metallic fibres, coated metals and fabrics covered with irregular glass particles.

Screens of this type may be made in one piece, but because of cost are usually made of standard widths of material sewed by a special process. The seams are usually vertical as it has been found that after they become dirty thy are least visible.

In the manufacture of screens it has been found that any gloss on the surface which produces regular mirror-like reflections may cause streaks at the seams. It is therefore best to use a screen which has no apparent gloss. This may be discerned by holding its face parallel to a light source and looking along it.

The advantages of white diffusing screens are:

(1) They redirect a large percentage of light, that is, they are very efficient.

(2) They are good for color picture projection, that is, they are not color selective.

(3) They redirect light through wide angles giving satisfactory projection for wide theatres and for theatres with steep projection angles.

The disadvantages are:

(1) A waste of light in many theatres because of the lack of controlled distribution.

(2) Too great brightness in the front seats.

b. The Directive Screen.

Directive screens are diffusing screens on which are imbedded spherical glass particles and they are commonly known as beaded screens.

The advantages are as follows:

(1) They concentrate the light into a beam which, in a house of minimum or narrow width, produces a brighter picture for rear and balcony seats.

(2) By the effect of this concentration more of the light is used to advantage so that in a house suited to them they are more economical.

(3) They assist in the illusion of a third dimension.

(4) They reduce the glare for the front seats.

(5) Because of their apparent brightness, they add life and brilliancy to colored pictures.

The disadvantages are:

(1) Because of their directive nature, they are suitable only for certain classes of houses.

(2) Defects of material are accentuated and must therefore be minimized.

c. The Reflective Screen.

Reflective screens are those with a polished surface, such as aluminum. By stippling or rippling the mirror effect is reduced to proper requirements.

Their advantages are as follows:

(1) They concentrate the light into a beam so that for narrow houses they produce a brighter picture for rear seats.

(2) They result in economies in houses which are suited to them.

Their disadvantages are:

(1) They are of low efficiency because of the reflection value of the surface materials used.

(2) They are not good for the projection of colored pictures as they are color selective.

(3) The openings for sound tend to have a peculiar effect on the picture because of the nature of the light reflection.

Because the effect of the light returning on itself in the case of the beaded screens, the projection angle is a definite limitation for the use of this type of screen. This limiting factor varies with the width of the house but in general it is safe to assume a limiting angle of 20°.

Efficiency in Illumination

IN these days of economizing and retrenching, it is surprising to find that comparatively little attention is given to the factors involved in the correct illumination of the motion picture screen through the projected picture. For here is a phase of projection which, if ignored, may often result not only in failure to secure the best results from all parts of the equipment, but also in extravagant waste of current.

This criticism is by no means confined to the smaller and often inadequately-staffed houses. As a matter of fact, some of the present outstanding examples of inefficient illumination exist in up-to-date and flourishing theatres, where one might expect to find the expert attention that their fine equipment deserves.

From the point of view of projection alone, and so far as the member of an audience is concerned, the projected picture may be regarded roughly as an illuminated photographic enlargement. And as the excellence of a photographic enlargement depends largely on the quality and grain of the paper used, so is the motion picture enhanced or marred by the reflecting quality and texture of the screen upon which it is projected.

It became apparent in the earliest days of motion pictures that an opaque surface would have to be substituted for the reflective sheet inherited from the magic lantern. The introduction of that opaque surface was the beginning of much controversy as to what constituted its ideal quality, and of a line of secret processes, patents and fantastic claims that ended only with the coming of talking pictures. The outstanding advantage played upon by the manufacturers of the opaque screen was its negligible amount of light absorption resulting in more brilliant illumination with minimum consumption of current. Electric current reductions claimed by some of these manufacturers ranged as high as 60 per cent.

"Talkies" Bring New Problem

When talking pictures emerged from the laboratory, the necessity for placing loudspeakers behind the screen as a means of aiding proper distribution of sound presented a new problem in screen manufacture. First, woven screens were devised. It was fully evident though that with the relatively little opaque quality of the woven screen, great increase of light absorption and consequent prohibitive current consumption was inevitable. Nor was that the only disadvantage. It was equally apparent that an open-weave surface would act as a trap for every particle of foreign matter in the auditorium's atmosphere, necessitating frequent cleaning of the screen.

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO.. 844 So. Wabash, Chicago.

The Perforated Screen

Then was realized the simple possibility of retaining the essential advantages of the opaque screen and providing at the same time much more adequate sound passage than hitherto possible. This was the so-called "rubber" screen. The rubber screen was a material surfaced by opaque treatment to give it a desirable reflectivity of projection light. The passage of sound in this screen was provided for by perforating the fabric with numerous minute holes in regular or irregular formation. This combination resulted in ample passage of sound and in a great saving of light absorbed from the projector.

But no idea, simple or otherwise, has yet been born perfect. It was soon found that unless the holes were cleanly cut in the fabric the frayed edges would in a short time collect enough dirt to affect seriously both the projection quality and the passage of sound. Moreover, the material used was not strong enough to withstand the weakening due to the cutting of the perforations and there followed the appearance of unsightly lines on the screen's surface.

It is interesting to note that in spite of their shortcomings a considerable number of these screens, including many of the old type fabric screens, are still employed. In many parts of the country the use of the fabric screen is now prohibited. One would think that apart from its ininefficiency, the expense and inconvenience of maintaining one of these screens would alone prohibit its use, for it must be sent away frequently for cleaning and fire-proofing. The modern properly-woven and cleanly-perforated screen on the other hand, besides conforming to fire regulations everywhere, may be cleaned as it stands.

Degree of Light Intensity

Just as excessive current, in a vacuum tube not designed to cope with it, results in distorted sound reproduction in the loud-speaker, so excessive illumination of the screen is a cause of bad projection. Ample but not excessive illumination from the arcs is, therefore, a matter deserving of more than casual attention. Circumstances, no doubt, determine to a large extent, what degree of illumination is best suited for a particular house. However, it is safe to say that it is a mistake in a theatre where throw and screen area unmistakably call for high intensity to try to get adequate performance out of a low intensity lamp.

The manufacture of the projection carbon has been carried by research to such a state of perfection that today—to draw a somewhat frivolous comparison—as there is a lipstick to match every known complexion, so is there a *specific* and *essential* type and combination of carbons to produce the best results for every condition of installation. The benefit derived by the correct use of carbons is common to both the manufacturer and the theatre.

Mirrors and Lenses

Another cause of inefficient lighting is the presence of a "dark spot" or other blemish due to inaccurate focusing of the mirror with the other components of the optical system. The replacement of the existing mirror by one not originally designed to fit the lamp is a common cause of this. The projectionist who knows his job will soon remedy the defect by means of a little experimenting, or if proper adjustment proves impossible, insist on a mirror purchased from the manufacturers of the lamp.

Frequent damage to the mirror from flame-lick in the case of projection at steep angles, may be simply and inexpensively remedied by the use of an arc flame control. Though this may be home-made, most projectionists will prefer to purchase it since the cost is quite moderate.

It is almost unnecessary to point out that good projection depends largely upon the type, proper design and quality of the lenses employed. Yet it is a fact that many an exhibitor who does not hesitate to spend money on the latest luxury in automobile equipment will balk at the prospect of any financial outlay to modernize the equipment upon which his livelihood and prosperity depend. Moreover, there is many a projection-room in which up-to-date equipment would, in the saving of current alone, pay for itself in twelve months.

Academy Nominates Officers

Nominees for offices in the Academy of Motion Picture Arts and Sciences for the coming year were announced today. The annual election of the organization will be held October 15.

Following are the nominations:

For the Board of Directors: Actors' Branch, Sam Hardy; Directors' Branch, John Cromwell; Producers' Branch, B. P. Schulberg; Technicians' Branch, J. Theodore Reed; Writers' Branch, Oliver H. Garret. Members of the Board serve three year terms, the expirations being on a rotating basis so that one vacancy in the representations of each of the five branches is to be filled each year.

For the Branch Executive Committees: (One year terms).

Actors' Branch—Edward G. Robinson, Chester Morris, Warner Baxter, Reginald Barlow and Hedda Hopper.

Producers' Branch—L. B. Mayer, B. P. Schulberg, David Selznick, Winfield Sheehan and Jack Warner.

Directors' Branch—C. B. deMille, Alfred Green, Robert Leonard, Rouben Mamoulian and Fred Niblo.

Technicians Branch—Hans Dreier, Nugent Slaughter, J. M. Nickolaus, John Arnold and I. James Wilkinson.

THIS BOOK IS A CHALLENGE TO EVERY PROJECTIONIST IN AMERICA

More Miehling books have been sold to projectionists than any other. . . . There have been others since Miehling's book was brought out . . . and all at a higher price . . . but Miehling's still remains as the only book written by a projectionist for projectionists. . . . That is why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of ALL sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

NOW ONLY

$2

SOUND
PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.

●

519 pages . . . .
Completely indexed
Fully illustrated.

Do Not Delay! Fill in this coupon and forward to us at once with your remittance. Do it now!

MOTION PICTURE PROJECTIONIST
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $2.00.

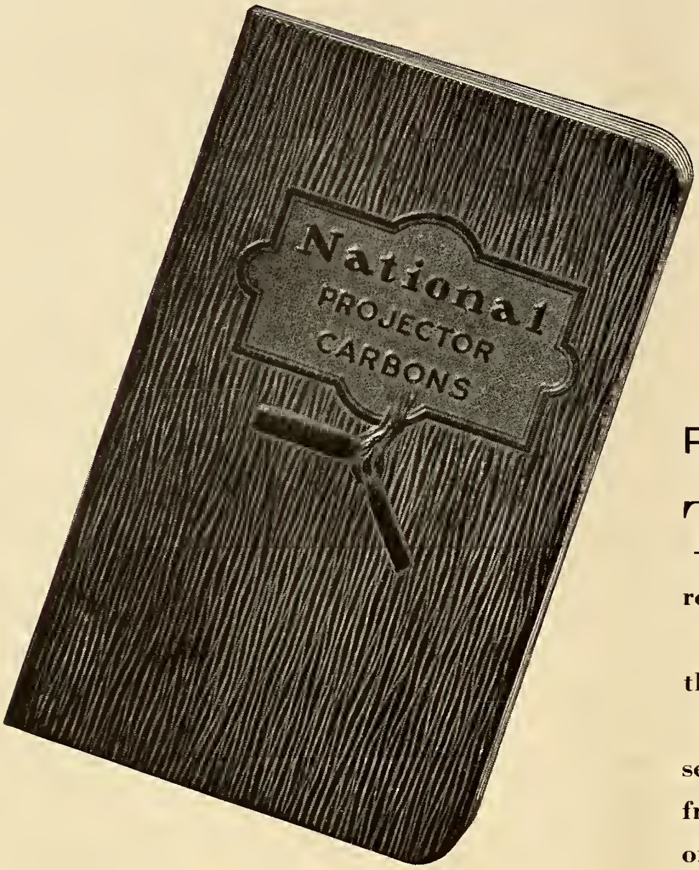
Name..

Address..

City and State..

Position..

Theatre..



A NEW HANDBOOK

on

NATIONAL
PROJECTOR CARBONS

96
Pages

58
Illustrations

FREE—TO EVERY PROJECTIONIST

THE new and completely revised edition of the National Projector Carbon Handbook is now ready for distribution.

This book discusses, in detail, the application of the carbon arc to all types of projection lamps.

It contains the practical information needed to secure maximum volume of screen illumination, freedom from trouble and most efficient operation of projection lamp equipment.

SEND FOR YOUR COPY TODAY
Use the coupon at the bottom of this page.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division . Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices:
New York Pittsburgh Chicago San Francisco

NATIONAL
PROJECTOR CARBONS

NATIONAL CARBON COMPANY, INC.
Post Office Box 400
Cleveland, Ohio

Gentlemen: Please send me complimentary copy of the New Handbook on National Projector Carbons.

Name____
Title__________________ Theatre__________________
Mail to __________________________________ Street
City__________________________State__________
M.P.P.10

MOTION PICTURE PROJECTIONIST

A FIRM FOUNDATION

DESPITE the hard times and the lack of profitable business neither of the two largest sound engineering companies have let up on their development work. RCA Victor has just announced its new High Fidelity Recording system which has a greater refinement than any of its recorders in use at present and a range greater even than is needed today. It is also ready with its reciprocal reproducing system which is announced in this issue.

Western Electric has kept pace with the times and its new recorders and reproducers achieve fine results in the studio and in the theatre.

The same is true of manufacturers of other types of projection equipment.

This is encouraging. It means that projection will not be permitted to slip back to pre-sound days when hardly any development work of any kind had been done for years. It means that the march will continue to better and simpler equipment safe in the hands of the finest engineering institutions in the country.

With the exception of WE and RCA we find no additions to the ranks of manufacturers of projection equipment. On the other hand very few old ones have dropped out. This record is a credit to the manufacturers: they builded well and carried on through fat and lean times serving the industry with the best machines they were able to turn out.

On looking backward it is also important to record how well these manufacturers rose to the demands of talking pictures.

DEC -8 1932

It was natural that Western Electric and RCA should set a fast pace from the beginning—a beginning to us, that is, but not to them because they had been working on sound pictures for a very long time before it was introduced to the public by Vitaphone. But our makers of lamps and lenses and screens, carbons and generators did not lack the vision or the experience to make changes and improvements to keep pace with the new projection.

Projectionists may depend on them and on increasingly better equipment. The craft is standing on a firm foundation.

Boone Mancall

SIXTH YEAR
of
PUBLICATION

Published by the MANCALL PUBLISHING CORP., Boone Mancall, President.
Editorial and Advertising Offices, 7 West 44th Street, New York City
Entered at New York Post Office as second class matter, October 25, 1927.

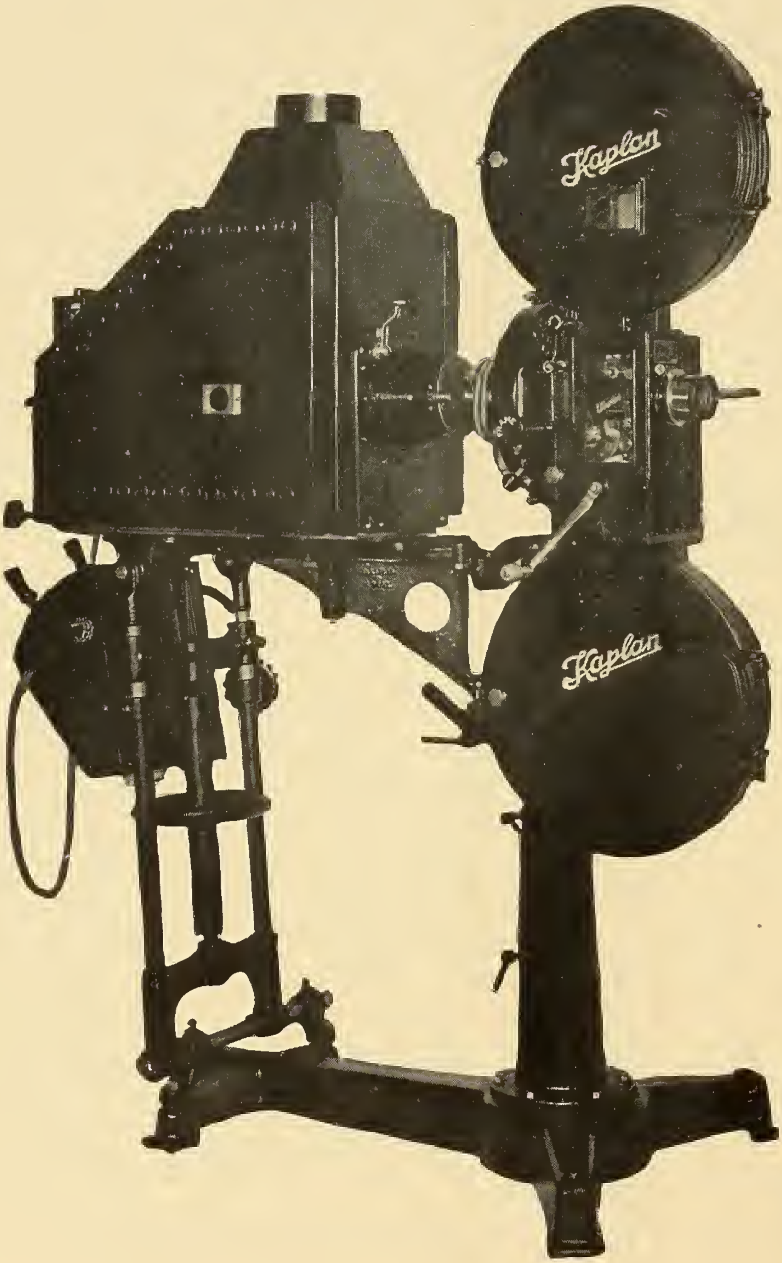
Vol. 6 No. 1
NOVEMBER, 1932
25c. per copy -:- $2.00 per year

THE LARGEST SCREEN IN THE WORLD

IN THIS ISSUE

Kaplan

PROJECTORS



Widely used in this country—known internationally, the Kaplan Projector is universally recognized as a product of the first rank. It has earned its reputation because it is designed and built on the best engineering principles.

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.

729 SEVENTH AVENUE
NEW YORK CITY

MOTION PICTURE PROJECTIONIST

November, 1932 Vol. 6, No. 1

EDITORIAL BOARD
CECIL B. FOWLER
ROBERT J. MARCY
KASKEL KALLMAN

Production.

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. ....Entered as second class matter October 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road,
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth Street
Melbourne, Australia.

Editorial & Advertising Offices
7 West 44th Street
New York City

National Advertising Manager
Boone Mancall

OUR PLATFORM

To maintain always the integrity of the original policy of this publication: that it be a means of raising the standards of projection by a ceaseless campaign of education among the many thousands of projectionists in the United States and Canada.

That every available inch of space in each issue be devoted to this end.

That we be interested in neither the politics or the personalities involved in the politics of the International Alliance of Theatrical Stage Employees and Moving Picture Operators or of any other group or body of projectionists, because such interference with internal affairs of labor organizations will make this a partisan and political paper and destroy its value to the craft which lies in educational work only.

That by maintaining our policy of education we will enjoy the support of projectionists everywhere for many years to come as we have enjoyed this support for the last five years as the leading projection publication in the country.

The Editors and Advisory Editors and the organizations with which they are affiliated do not necessarily endorse all the statements or opinions offered in this magazine. The author who signs an article assumes full responsibility for the statements it contains.

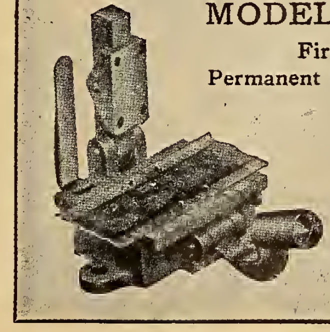
DON'T

SPLICE FILMS THE
OLD, MESSY WAY . . .

. . . EASTMAN Sound Film Patches do the job more quickly, neatly, and dependably. Because of their design, they are practically inaudible in projection. At the same time they obscure a minimum of the sound track, and assure fast, accurate, and clean treatment of all splices. Together with their precise registration block they represent a valuable yet inexpensive feature of Eastman service to the motion picture industry. Eastman Kodak Company. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

USE EASTMAN
SOUND FILM PATCHES

Universal Film Splicing Machine



MODEL NO. 3 Pat. March 22:22
First-Class Results on New or Old Film
Permanent Gauge No Adjusting
FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS
Price $6.00
GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers

The World's Largest Screen

The specially designed screen which has been installed in the RKO Theatre in Radio City is the largest ever built for a motion picture house. It measures 60 by 30 feet.

The hitherto largest screen in the world, utilized for wide-film pictures, measured 42 by 20 feet, with a surface of 840 square feet. The average 4,000 seat house uses a screen measuring 18 by 16 feet. The area of the Roxy screen is 1,800 square feet, approximately 1,500 square feet larger than the screens used in a house of the capacity of the RKO Roxy.

The new screen of the RKO Roxy affords a greater comfort and enjoyment to the audience by diffusing an identical amount of screen light as viewed from any part of the theatre.

It represents the exhaustive researches of Albert B. Hurley, New York physicist, who invented a special process to eliminate directional rays and substitute a system of even diffusion of light on the screen. In the past, light rays reaching the screen from the projection machines reflected at the angle of refraction, precisely as they would in a mirror. Spectators viewing a picture from an elevation or extreme side of the house would find the image slightly broken, distorted or glaring. The new screen arrests the light rays and achieves an even diffusion of light, so that no matter where the spectator is seated, the image is seen clearly and unblurred.

Four Picture Sizes

Another important innovation is a special equipment whereby the size of the screen can be changed at will. The picture sheet frame is of a size capable of screening the largest wide film and is also adaptable to four different picture sizes. Hitherto, the most advanced type of screen has been limited to two dimensions, one for the ordinary size picture, and the second for the so-called wide-film magnifying size.

New Possibilities

The huge sheet in combination with the device for changing it to any desired dimension, makes it possible to keep in step with all the latest developments in wide picture projection.

The great scale of the new screen makes possible the initiation of daring experiments in screen projection and thus increases the imaginative possibilities of picture presentation. The means of transposing the screen to varying sizes is a motor-operated mechanical device which masks the screen as required. This is effected by running the side maskings in and out, and the top border up and down, till the screen opening is the proper size. It is then a simple matter for the projection crew to set the limit switches on the masking machines, lock them in place, and establish the pre-determined size of the opening obtained at that selting.

This done, the projectionist need only press an electric control button marked for the size of the picture, and the maskings move out automatically and stop at the desired screen size.

NOT ONE IN 10,000

NOT one patron in ten thousand knows an anastigmat from an aperture . . . but when the picture he sees on the screen is strong, clear and sharp . . . where there are no smudgy edges to distract him, he gets a lot more satisfaction from the show. He likes the house. He'll come again.

The shows you take today have got to be good. They deserve and *require* the *best projection.* Show them with the new Super Cinephor . . . and treat yourself to the added good-will of increased patron pleasure.

Here are the highlights of its superiority. 1. It is the first true anastigmat, fully corrected for spherical and chromatic aberration. 2. It is available in focal lengths down to 2 inches. 3. It gives full detail *right to the edge.* 4. New B&L Condensing System used with Super Cinephor transmits 50 to 100% *more light* to the screen . . . insures high screen brilliance.

Ask your National Theatre Supply man about Super Cinephor and mail coupon today, for complete details. You'll like the sound of the price. It will prove its value on the first job.

SEND THE COUPON TODAY

The Catalog Contains Valuable Information for Projection Men

BAUSCH & LOMB OPTICAL CO.
680 ST. PAUL STREET ROCHESTER, N. Y.
Please send complete details on the new B&L Super Cinephor.
Name...
Address...
City...State...

BAUSCH & LOMB OPTICAL CO.
680 ST. PAUL STREET ROCHESTER, N. Y.
Bausch & Lomb Makes Its Own Optical Glass.
Only B&L Glass Meets B&L Standards

MICROSCOPES · TELESCOPES · BINOCULARS · SPECTACLE LENSES AND FRAMES
OPHTHALMIC APPARATUS · SCIENTIFIC INSTRUMENTS

Subscribers to the MOTION PICTURE PROJECTIONIST who send in changes of address must make an allowance of at least four weeks before the new address becomes effective.

Whenever possible special copies will be sent to subscribers' new address so that they may not miss any issue of the publication.

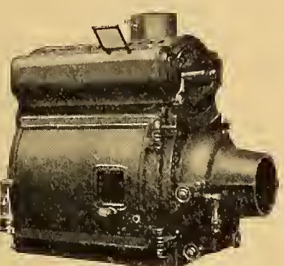
If any subscribers have missed issues because of address changes please let us know.

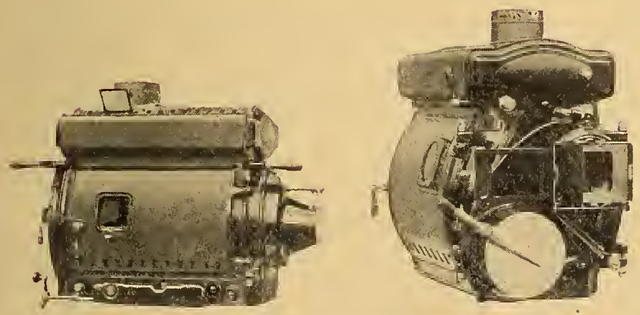
—*Motion Picture Projectionist.*

Brenkert

Projection Lamps

in theatres from coast to coast are daily producing highest quality projection at low operating cost.





Super High Intensity — Hilow — Standard Intensity

A size and type to meet any projection requirement.
Sold and serviced by independent supply dealers.

WRITE FOR LITERATURE

A
Brenkert
PRODUCT

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROI

- Built-in Reflector Arc Lamp, latest type with ample capacity for screen distances up to 150 feet. Perfect optical alignment.
- R. C. A. Sound Reproducing Assembly, latest design, built-in, rugged in construction, rigidly mounted and compact.
- Entire projector consists of separate assemblies, any one of which may be removed without disturbance to other parts.
- Simplex engineering throughout. New, lubricating system insures positive oiling of all rotating parts.
- Entire mechanism simplified and refined—a sound and projection equipment that meets every requirement.

Simplex-Acme

—a PERFECT Sound-on-Film Projector

A compact designed, scientifically balanced complete projector unit that operates with far greater precision and smoothness than is possible with individual sound attachments on regulation silent film projectors. The Simplex-Acme is the latest scientific development of The International Projector Corporation and R.C.A.—the finest equipment ever before offered and priced at a figure any theatre can afford to pay. It meets the requirements of the most critical projectionists and engineers and effects substantial economies in operation . . . We are ready to demonstrate this remarkable unit. *The Coupon,* below, will bring you complete information, without obligation. *Mail it today.*

NATIONAL
THEATRE SUPPLY COMPANY

YOUR LOGICAL SUPPLY HOUSE

APPROVED BY COAST-TO-COAST NATIONAL THEATRE SUPPLY COMPANY DISTRIBUTORS

MAIL THIS COUPON TO NATIONAL OFFICE NEAREST YOU

Gentlemen: Send full details about the new Simplex-Acme unit. We are now using......................projectors with.................
(make) (make)
sound equipment. Our throw is.............feet.

Theatre ....

City .... State ....

Signed ....

GET YOUR COPY

SIMPLIFIED
SERVICING
OF
SOUND
EQUIPMENT

• • •

By Lloyd Harding

$2.00
We Pay Postage

COVERING EVERY W.E. AND R. C. A. TYPE OF EQUIPMENT

MOTION PICTURE PROJECTIONIST
7 W. 44th Street, New York City

Please send me copy of SIMPLIFIED SERVICING OF SOUND EQUIPMENT. Enclosed find two dollars.

Name ....

Street ....

City .... State ....

New Carbon Company

The recent development of C. Conradty, Nuernberg, Germany, manufacturers of carbon and carbon products since 1855, holds promise of interesting activity in this country.

The first definite indication of actual operation here was marked with the establishment of their New York headquarters under the name of Noris Carbon Co., Inc., with executive and sales offices in the Mohawk Building, 160 Fifth Avenue. Eric W. Schumacher, who has recently returned from an extended stay in Nuernberg, has been elected President and Managing Director.

Eric W. Schumacher

"Most American concerns," states Mr. Schumacher, "who have used carbon and carbon products, are quite familiar with the name Conradty. Both in America and practically every country in the world, Conradty has been identified with high quality products. Its forward place of world leadership in the sale of Projection Carbons to the Theatre and Radio industries is a record maintained through several decades. Now, with the extensive preparations the Nuernberg factory has provided for the supply of its supply of its products to the American market, Conradty's superior carbons should enjoy the wide acceptance here as it does universally abroad."

Already, evidence has appeared of the intensive advertising and sales campaigns completed by Noris Carbon Company.

Electrical Research Products Wins Contract

Electrical Research Products has been awarded the contract for the installation of a Western Electric Sound System in the Keystone Athletic Club, Pittsburgh, Pa., General Sales Manager C. W. Bunn announced yesterday.

The RCA Victor Company

ANNOUNCES HIGHEST FIDELITY SOUND

The supreme achievement in the field of sound reproducing equipment

for theatres of all sizes

Assuring accurate reproduction of the widest ranges in sound recording attained in the production of *any* sound-on-film motion picture at *any* studio

NOW AVAILABLE IN FOUR TYPES:

STANDARD SUPER SIZE
For Theatres having 2,500 to 4,000 seats.

STANDARD LARGE SIZE
For Theatres having 1,400 to 2,500 seats.

STANDARD SMALL SIZE
For Theatres having 600 to 1,400 seats.

SPECIAL SIZE
For Theatres up to 600 seats.

LEASE FOR CASH or DEFERRED PAYMENTS

The only all AC Operated Equipment for both large and small theatres.

NEW FEATURES OF STANDARD SUPER, LARGE and SMALL SIZES

1. New "rotary stabilizer" soundheads—no sound gate—no flutter—no "wow"—free running drum.
2. Direct drive soundheads—no chains—no belts—few parts requiring replacement—simplest possible design.
3. Improved AC operated amplifier—extended frequency—richer tone—more natural sound.
4. Remote Volume Control at projector station and auditorium on larger equipments.
5. Ten-foot loudspeakers for DeLuxe theatres to give reproduction of maximum frequency range—particularly low frequencies.

SPECIAL SIZE

1. Greatly improved AC operated amplifier—highest fidelity sound—flat characteristics—greater power.
2. DC exciter lamp—more low frequencies.
3. New monitor amplifier speaker—no power diverted from main amplifier.
4. Belt drive soundheads—no noise—smooth operation.
5. Separate fader switch for wall mounting.

Orders now being accepted for December delivery.

For detailed information concerning this new equipment or the modernizing of your present apparatus, communicate with

PHOTOPHONE DIVISION

RCA Victor Company, Inc.

Camden, N. J.

RCA HIS MASTER'S VOICE

Branches Principal Cities of the World

More Machinery More Jobs

By S. M. KINTNER*

UNEMPLOYMENT is a matter of world-wide concern, and it is only fair that some thought be given to the part played by technical progress and its production of labor-saving machinery, in creating such a condition.

As one walks through great factories, or studies the processes of modern industry, they cannot fail to be impressed by the great amount of labor-saving machinery and, consequently, the large output of product per unit of labor employed. However, it is not safe to draw conclusions from that observation alone. Some of these vast industries have been created from nothing, insofar as their effect on labor is concerned.

This is apparent when, for example, we think of the millions employed today in the automobile industry—in the making, the selling and servicing of the large number of such mechanisms, whereas fifty years ago there were none.

The same lesson can be learned from studies of the electrical industry, of which there was none one hundred years ago; of the radio; of the telephone and telegraph; of the motion pictures and a number of other industries created as it were from nothing, but now employing millions.

The general use of power, developed by waterfalls or steam and distributed by means of electricity, and of power produced by the mobile internal combustion engine, in contrast to one hundred years ago when the efforts of beasts of burden and those of human beings were the principal sources of power, has completely changed our methods of living. The effects of this general use of power has revolutionized the construction of our cities—a change that has taken place within the memory of many of those now reading these lines.

Out at Hoover Dam is being done a job larger than the Egyptian pyramids. It is being done in a few years, instead of in several lifetimes—by electric shovels and cableways and other machinery, instead of by an army of straining slaves, bleeding under the lash. The equivalent of the machinery on that construction job, in terms of human labor, would run into figures that would rival those of the census, and yet machinery has not robbed that vast imaginary multitude of work; for with hand labor the enterprise could not have been thought of and, even as it is, there is a very respectable city of workers on the spot.

Technical progress is still hard at work, creating good new jobs by the millions for tomorrow, not only in new lines, but in old ones. When hard times struck three years ago, billions of dollars worth of machinery in plants all over the country was carefully put away, until it should be needed. When its owners take it out again to use, they will find much of it as useless as if they had let it rust—technical progress since 1929 has made it as out of date as a silent movie. Even in three years, new machinery has been made so much faster, lighter, safer, more efficient, that it will not pay to use the old. And the reequipping of the country with modern machinery will alone go far to make prosperity.

Still greater possibilities lie in the now undreamed-of arts, businesses and industries that this fairy of technical progress will almost certainly produce from her magic box. Fifty years ago, men found they could use electricity for light. Forty years ago it was lighting everywhere. Thirty years ago, it was running factories, and producing new materials. It is only twelve years since it began to be a voice to reach the universal ear, and it seems only yesterday that it became the universal amusement, the sole actor in ten thousand theaters.

Why should we suppose that its possibilities are exhausted? It is not reasonable to expect that new industries, each demanding an army of workers, will appear from the source whence so many have already miraculously appeared?

So many prophesies of the past that have sounded a warning of a finished world, have proven so foolish when viewed in the light of subsequent events, that it must take a brave, and I might add, foolish man to record his opinion to that effect as a result of our present troubles.

Imagine what the present day farmer must think of Malthus warning at the beginning of the 19th Century, that unless the rate of growth of the population was controlled, humanity would starve—as they would not be able to raise sufficient food to sustain themselves.

Malthus lived long enough to see the start of the machine age, but short of a time when he could realize that it had completely nullified the conditions that aroused his fears.

No doubt the tendency of the age towards shorter and shorter working time will continue. Furthermore, it is highly probable that as we work more into this new order of things, workers will enter active work at a later period than now, and similarly retire at an earlier period in their lives. Such a plan will be necessary if the worker is to have an opportunity to enjoy the many new devices that are to find their way into existence as well as assist in the better distribution of jobs.

Many of us have witnessed the change in working hours, first from sun-up to sun-down in the earliest days of this generation, to a twelve-hour day, then a ten-hour day; to be followed by an eight-hour day—now we are likely approaching a six-hour day, and the present change is much greater than the preceding ones and, consequently, more difficult to adjust.

Who would want to retrace our steps and throw away all our labor-saving machines, in order that we might have more jobs? Surely no one who gives the question serious thought. What is needed is a new plan of operation that will give due consideration to our new order of things and permit us to enjoy this millenium of freedom from drudgery and leisure for thought and pleasure —the end towards which we have all striven for so long.

Such a plan to be successful must still hold out rewards for the ones who do the best in still further improving condition. The incentive to do better must still be preserved.

---

*Vice President, Westinghouse Co.

Geared Motors

IDEAL Geared Motors have devised a gear reduction unit which is built integral with the motor. No motor coupling is used as the high speed gear is mounted directly upon the motor shaft. These units are available in all gear ratios from 2.09 to 1 up to 376 to 1, giving output speeds of from 861 r.p.m. to 4.7 r.p.m., using the standard 1800 r.p.m. motor supplied with these units.

For reduction ratios up to about 6 ot 1, the reducer consists of a single stage helical gear unit. For higher ratios up to and including 24.5 to 1, a two-stage helical gear reducer is used. For reduction ratios of 30 to 1 and higher, one stage of helical and one stage of heliocentric gears gives the required reduction. All gears run in an oil bath and anti-friction ball or roller bearings are used throughout. The units employing heliocentric gears have the motor hung on the reducer. Other units have the reducer hung on the motor.

Geared Motors are supplied in all horsepowers from ¾ to 20. Either open or enclosed type motors are furnished, for 2 or 3 phase alternating current, or for direct current. The motors are the recently developed IDEAL "Unit Type" construction with feet on the end brackets and with standardized rotors and stators which are interchangeable throughout all types. Two, three or four speed motors can also be supplied.

Sound Absorption and Materials

By GEORGE W. BAKER

In the discussion of sound absorption and its relation to theaters I have limited myself to the concepts and materials in commercial use today.

When absorption is spoken of we mean the change of sound energy into other less objectional forms. This change of energy might be into the form of heat or mechanical work but which ever it is we are rid of the annoyance caused by the sound energy that is excessive reverberation, troublesome reflections, etc. Sound impinging on a diaphragm of a microphone is transformed into mechanical work while sound impinging on a finely porous material is transformed largely into heat by friction. The use of these acoustical facts especially the latter, enable us to correct and to build acoustical correct rooms in which all the auditors can hear to a perfection. Having a transforation of energy it is only natural that the scientific mind should turn to a means of measurement and expression so that the engineer and acousticians can use it in their work. Wallace Sabine, one of the pioneers in the study of acoustics, devised a unit in which absorption could be expressed. He compared all absorbing materials to an open window, since all the sound impinging on an open window passed through. He gave the open window a coefficient of one or one hundred per cent absorption, based on an area of one square foot. Now anything which absorbs only part of the incident sound energy will have a coefficient less than unity and will mean that per cent absorption as compared to a square foot of open window.

Methods of Measurement

There are several methods of measuring the coefficient of absorbing materials. The reverberation method in which the reverberation time of the bare room is obtained, the material to be tested is then placed in the room and the reverberation time is again obtained. From the two time values one can calculate the value of the absorption. This is the method used at the various laboratories throughout the country. It has several disadvantages in that it requires a very large sample of the material and a considerable number of measurements. Another method makes use of the well known law of optics, in which the angle of reflection equals the angle of incidence. Sound is allowed to impinge, from an angle, on the material to be tested. The ratio of the reflected intensity of the material to the reflected intensity of a non-absorbing blank, is considered a measure of the absorption of the material. The apparatus must be calibrated against samples of known coefficients. This method requires small samples consequently it can be used to study the variation of absorption coefficients between individual small tile.

Another method is known as the tube measurement in which the sample is placed at one end of a small diameter tube and a source at the other end. Standing waves are set up in the tube and the points of maximum and minimum pressure are found by means of an exploring microphone. From the two pressure values and their respective distances from some known point on the tube, one can get the absorption coefficient. This apparatus must be calibrated by samples of known coefficients. This method is not very favorable because of mechanical difficulties which present themselves to the technician. The mineral wood sample, manufactured from a slag blown into cold water, has a high coefficient of absorption, i.e., about .82. Due to its dustiness it must be enclosed in a cloth sack. However, this sack does not have an appreciable effect on the coefficient since the sound pulse passes through the cloth, as if it were not there. The pad formed is placed behind a perforated metal pan and the whole suspended from the ceiling.

Sound Absorbing Materials

The sample of acoustone is made from mineral wool and other substances mixed with a binder and cast into molds. The material can be made into various shapes and by the addition of various dyes which can be made into a very decorative product. The absorption coeicient is about .61. Due to its surface and the various shapes and colors into which the tile can be made, it is used as a ceiling as well as a wall decoration for sound treatment. The material may be spray painted, several times before the absorption coefficient begins to decrease appreciably.

There are many forms of sound absorbing products such as hairfelt, flaxolinum, cork board, masonite, insulite, pyrocell, celotex, etc. Celotex is a shredded wood product drilled with holes at a definite spacing. These holes form an access into the interior of the material more readily and thus the higher value of sound absorption is obtained, (coefficient between .63 and .70). The material has the advantage in that it can be brush painted as many times as necessary without suffering a decrease in absorbing power. The holes must not be filled with paint. Weatherwood, masonite and presswood come under this form of absorbing material. The coefficient of the undrilled material ranges from .18 to .80 depending upon the porosity and thickness of the material.

Reverberation Time

I have been talking about absorbing material and the various coefficients; but what about how to use them and what are the most efficient uses for them. If we take a medium untreated room (volume about 10,000 cubic feet) with hardwood floors, plaster walls and ceiling, we will find that when we speak or play music, the various individual syllables or notes can be heard for several seconds after the sound has stopped. There will be interference between the notes as they follow one another. In talking to another person in this room we will find that we have difficulty in being clearly understood. This is due to the various reflections from the walls, floors and ceiling; in other words when the path of the direct sound from the source is considerably shorter than the path of the reflected ray, we hear the note as many times as it is reflected. Since the difference in path is related to time we have only to find the ideal hearing time as it were and use this time in the construction of further rooms. Again we are interested in the time necessary for the sound of an initial intensity of 60 db to decay to inaudibility. This time is known as the reverberation time of the room. When this time and the time difference in paths are correct in a room, ideal hearing is assured. Wallace Sabine, has given us a formula which is almost universally used in the calculation of reverberation time, but it does not apply to dead rooms, i.e., highly treated rooms. For our purpose Sabine's formula will suffice for the room we have under consideration. Though a great many observations on various individuals it has been found that if the time difference in paths of the direct and reflected sound is less than about .06 seconds, we will be unable to notice the phase difference between the two rays. By the same process of experimentation on rooms of various volumes it was found that an optimum curve or reverberation time could be drawn and from this curve the time for any room could be found.

Use of Sabine's Formula

In the room we have under consideration the optimum reverberation time is about 1 second. Substituting this time and the volume of 10,000 cubic feet in the formula we can solve for the amount of absorption. This absorption consists of the produce of various areas and their corresponding coefficients. In order to get the amount of absorption we need to have the room corrected, we must subtract the

(*Continued on Page* 32)

**U. S. Gypsum Company. From a paper read before the Chicago Section S. M. P. E.*

Correct Colors for Projection Room

By HOWARD KETCHAM*

THE human eye is nature's closest reproduction of the camera. In place of a movable plate for securing a focus, the eye has a stationary plate known as the retina. The picture of objects close by or at a distance is shown on this retina by means of a movable compound lens controlled by muscles.

The eyeball is made up of three membraneous layers enclosing a series of transparent substances—the aqueous humor, the crystalline lens and the vitreous humor. Each of these substances serves as a lens for the refraction of light rays. Combined, these substances form a convex lens.

Three membraneous coats serve to protect the eyeball. The first of these coats includes the clear portion of the eye, called the cornea. The middle coat is black, for protection against all rays of light not entering the center or pupil. The front part of this membrane is called the iris and it is brown or blue in color. By opening or closing the iris, the amount of light to reach the retina is controlled. The retina is the last coat and is the most important division.

The retina is made up of ten layers of membraneous material. The ninth layer is primarily concerned with vision and consists of rods and cones. These rods and cones are the particular agents of brightness and color respectively. These agents resemble in appearance the shapes for which they are named.

The Physiology of Color

In the absence of any definite knowledge of how we see, certain physiological and psychological hypotheses have been built up. The eye is made so as to focus light right on the retina. The light rays from an object are refracted by the lens of the eye and pierced through the inner layers of the retina, exciting the rods and cones. These rods and cones stimulate the optic nerve. This nerve transmits the excitation to the visual area of the brain. Thus it is through the central part of the eye that we receive our direct and clearest vision. The normal eye is comprised of about 130,000,000 rods and 7,000,000 cones.

It is thought that the rods mediate brightness and that the cones mediate colors as well as light. It is further thought that the cones are sensitive to three color stimuli, red, green and purple; certain sets of cones responding individually or collectively to these spectral primaries. We know that pure green light merged with pure red light produces yellow light. Similarly green with purple, and purple with red produce other intermediary colors. Combinations of these primaries serve to produce every observable color.

When we look at a bright red object intently for ten seconds and then transfer our gaze to plain white surface, an after image develops and we observe the complement of red, which is blue-green. By looking at any bright color in this manner, an after image representing the color's complement will be observed. This phenomena is believed to show the importance of balance in any color arrangement whether it is for use on a car, an advertising illustration or the interior fittings of a room.

Color Balance

Unbalanced color schemes, that is, color arrangements in which there is too much of a single bright color predominating, tend to tire the eye and upset the nervous system. Different colors have different effects on each individual. The important fact is that when the rods and cones of the eye are excited by an impression of red unrelieved by its complement, the sets of these agents responsible for the red impression transmitted to our brain tire and fold over, bringing into play the unused agents which respond to the complement of red and in this way we see the after image, blue-green.

Properly balanced color schemes, representing a carefully arranged relationship of colors and complements, balance and rest the eye by using all agents equally. This thought helps us to realize the tremendous importance of surrounding ourselves, particularly in places where our best efforts must be put forth, with proper color relationships.

In a room, such as a motion picture projection booth, certain fundamental aspects of color may well be considered. Dark colors, bright colors or decorative features are to be avoided because treatments of this nature would tend to make the room seem smaller than it really is and the patterns would create a disturbing mental effect upon anyone working in such close quarters.

We know from observation of flowers in a landscape viewed at twilight that the green and blue colored blossoms retain their brightness long after the red and yellow hues have faded into grays. Green appears to be intensified by faint light and blue is next in importance from the standpoint of this consideration.

Best Colors for Projection Room

Because the right arrangement of color in an operating booth can contribute a therapeutic effect conducive to repose or quick recuperation from fatigue, it seems essential to consider colors for this purpose.

The ceiling in a tint of lemon yellow will enable the operator to see more easily his work than would a ceiling in white, because lemon yellow has more light reflective properties than any other color, including white. In order to finish the walls of the booth as attractively, as suitably and as practically as possible, tints of blue or green can be employed to excellent advantage.

Green is characterized by vigor and appeal. It has a cool, passive, refreshing and restful mood. A booth with green walls should be illuminated with white light, as this will keep the walls looking green. Colored lights will tend to destroy the appearance of the walls; yellow light making the walls appear green-yellow, and blue light making them look blue-green. A plum colored floor and woodwork would be sufficiently complementary to the green walls to provide appropriate balance.

As an alternative, blue walls can be used, the characteristics of this hue being tranquility, calmness and expansiveness. Light tints of blue will tend to make the booth appear larger. Blue's mood is cold, deep and passive. Here again white light should be used, if the original color of the wall is to be preserved. Yellow light on blue walls will create a dark green effect, while an orange light will serve to make the blue walls look very dark. A blue light will darken the appearance of blue walls. Light brown woodwork and floors will sufficiently complement blue to balance the color scheme.

An exceptionally small booth could be finished all over in a tint of lemon yellow, as this color arrangement will provide the maximum light and will make the booth appear as large as can be made through the use of color. However, the energizing effect of a dominating hue, such as this, is apt to prove tiring.

Blue and green, being cool colors, are appropriate for use in a room where heat is generated.

The use of indirect lighting is recommended because it will guard the operators against the fatiguing effects of direct masses or spots of light. The right luminous system will prove most decorative in character and will cooperate most efficiently with the colored environment.

We are all unconsciously aware of the influence of color. Our likes and dislikes are founded on laws which are the basis of color harmony. A correct environment plays an important part in good work. We can sensitize ourselves to good work by having abundantly harmonious colored surroundings.

**Director Color Advisory Service, Dupont de Nemours & Co.*

Latest Development in Reproducers

By G. K. RUDOLPH*

WITH the development of an entirely new sound head that utilizes a rotating drum instead of a gate for sound take-off and with the existing highly successful all-AC-operated equipment as a basis for design and performance, the RCA Victor Company announces the introduction of what is referred to as Highest Fidelity Photophone sound reproducing equipment for theatres and auditoriums of all sizes. It is claimed that this new apparatus will reproduce the widest ranges in recording that have been or may be attained in the production of any sound picture at any studio. Recent demonstrations of this apparatus, employing the new RCA Victor High Fidelity system of recording, reproduced sound frequencies ranging from 40 to 9,500 cycles with a richness and clarity of tone and speech that have never before been attained.

Four Types

Four types of Highest Fidelity equipment have been designed—the standard super size, for theatres having from 2,500 to 4,000 seats; the standard large size, for theatres having from 1,400 to 2,500 seats; the standard small size, for theatres having from 600 to 1,400 seats, and the special size, for theatres having up to 600 seats. All types are AC operated, with newly developed and designed voltage amplifiers that are identical for each type. The first major installations of this new equipment are now being made in the new RKO Roxy Theatre and the Radio City music Hall at Rockefeller Center. Obviously, because of the magnitude of the Rockefeller Center building enterprise as a whole and particularly with respect to these two magnificent palaces of amusement, the sound reproducing equipment installations will be the most complete ever undertaken in connection with the building of any theatre in the world. Already, in addition to the new RKO Roxy and the Radio City Music Hall, contracts have been accepted for installations in a number of other theatres.

New Features

Outstanding features in the new apparatus include the improved sound head of the drum type, quieter AC amplifiers and extended frequency range, directional baffle and improved cone speaker. Of interest to exhibitors whose theatres have been recently equipped with Photophone apparatus is the fact that at moderate cost the equipment can be modernized.

The amplifiers for the Standard series are mounted on standard channel iron racks, the height of which has been increased to 82⅞ inches. The voltage amplifiers on the three types are identical. The power amplifiers vary, the standard small size using one 10-watt unit, the standard large size two 10-watt units, and the standard super size one 40-watt unit. The voltage amplifier unit has been slightly modified to give improved response.

The Fader Relay Switches are mounted on a box with a relay and remote volume control button, if used, together with a photocell voltage control for mounting at each projector station.

Loudspeaker Equipment

The 50-inch directional baffle loudspeaker is furnished regularly with the standard series equipment. The best results are obtained from a 10-foot directional baffle loudspeaker which can be furnished at an additional charge. The larger baffle reproduces low frequencies with about the same output as the higher frequencies and is more directional than the shorter baffles for low frequencies. Since this results in the reproduction being more independent of the acoustical characteristics of the auditorium, the 10-foot directional baffle loudspeaker should be installed in de luxe theatres wherever possible.

A loudspeaker filter is provided to compensate for the response at 300 cycles, thereby providing it is believed the smoothest and widest frequency range of any loudspeaker yet produced and eliminating the necessity of using a low and high frequency unit to cover the frequency band.

A loudspeaker coupling transformer is furnished with the two larger equipments to make possible the relative adjustment of the power supplied to the speaker.

The monitor loudspeaker furnished includes a 16-inch metal directional baffle with volume control and speaker unit, providing an extremely efficient unit.

Special Size Equipment

The special size equipment (PG-59) has been revised to have approximately the same fidelity of reproduction as the larger equipments. The frequency characteristic has been increased considerably in range.

The new amplifier for the special size equipment is mounted on standard channel iron rack 38½ inches high. It includes a single amplifier unit with a power output of six watts and employs an RCA-57 an RCA-56, four UX-245 and two UX-280 Radiotrons. It uses a double push pull power stage. Two exciter lamp supply units are included. Loudspeaker field supply is provided from the amplifier unit.

The sound head attachments, PS-22 for Simplex, and PS-21 for Powers 6B, are the same as the belt-drive attachment formerly used with this type of equipment except that the AC exciter lamp transformer is not required.

A Fader Switch for wall mounting between the projectors is furnished.

The 37-inch directional baffle loudspeaker is furnished regularly with this equipment.

A monitor amplifier loudspeaker consisting of a speaker unit and amplifier unit mounted in a metal box is included with the special size equipment. This amplifier unit consists of a simple push pull power stage using two UX-245 and one UX-280 Radiotrons. Through the use of a separate amplifier no power is directed from the stage loudspeakers for monitoring purposes.

No additional amplifier is required with this new equipment for theatres up to 600 seats.

Portable Apparatus

In addition to the permanent types of equipment designed for the reproduction of high fidelity sound, the RCA Victor Company manufactures 35 mm. portable apparatus and only recently introduced a new 16 mm. 400-watt sound-on-film portable and an automatic continuous projector that have begun to attract widespread attention.

---

*RCA Victor Company.

Poor Pictures vs. Good Equipment

Despite the carping of critics it cannot be denied that better motion pictures are being made all the time. Story material may be no better, but stories on the screen today are well-knit convincingly presented and, for the most part, satisfying. Hollywood studios having taken advantage of the latest technical developments, further improvements along the line of sound reproduction now awaits the offerings of the engineering laboratories.

In our interest in equipment, however, some of us have lost sight of the picture. No picture has ever been ruined by good projection equipment. On the other hand, no projector has yet been invented to make up for a mediocre scenario or poor acting.

Wanted: More Cooperation

By ROBERT SEELEY

EDITOR'S NOTE: In the October issue of the MOTION PICTURE PROJECTIONIST we published an article by Mr. Dan Cutler entitled, "I Consult My Projectionist." Subsequently we had an opportunity of discussing this article with another exhibitor, Mr. Robert Seeley, who subscribed wholeheartedly to Mr. Cutler's views and added some observations out of his own experiences. The interview appears on this page and is another valuable perspective of the exhibitor's views of projectionists and projection matters.

MR. CUTLER'S article is very true. I have had the very same experiences. I have often had occasion to thank the intelligence and loyalty of my projectionists. On the hand I have sometimes wished I could get more cooperation from them. As Mr. Cutler explains, it is about fifty-fifty. Sometimes the exhibitor fails to encourage the cooperation of the projectionists and sometimes the projectionists don't care. I suppose the latter fall into the classification in industry as clock-watchers.

I have been managing theatres for a good many years and of course my experiences are many and varied. But like most managers I find that the projection room gives me the most anxiety. It isn't that we do not trust our projection staff—on the contrary I seldom had to ask for a change—but the fear of a dark screen, of some equipment suddenly breaking down, of the loss of sound, these things prey on every manager's mind.

Before sound it was much simpler. There was an occasional breakdown. Sometimes part of the equipment broke down but more often it was a broken splice. Even that might have been due to the carelessness of the projectionist but it wasn't serious. In a few minutes it was corrected and the show went on.

Today projection equipment is more varied—and more complicated. A break somewhere in the projection room may be due to a cause that lies deep in the equipment and may take some time to correct. Again sound equipment requires a special training for quick servicing—I suppose that is why we have our service engineers—and it happens that in such a case the projectionist is left standing helpless before a break while a hurry call goes in for the service engineer. We are lucky if we can get him at once.

I mention all these things because cooperation between manager and his projection crew is necessary now more than ever. There isn't one of us who wouldn't like to have the feeling that our projection crew is absolutely dependable in fair weather and foul. And most of them are dependable.

I have had some fine boys work for me. Some of them I wouldn't trade for the best so-called engineer in the world. They knew their equipment and they could run it almost blindfolded. When it came to trouble-shooting, none could touch them. They were loyal, conscientious, friendly and helpful. They often saved me money.

I like to think that most of the projectionists of the country are like that. I have little cause to feel otherwise despite the few disappointments I have had. I think it is a pretty safe statement to make that a projection union is made up of the best men available and gives the exhibitor a feeling of security he cannot secure from the employment of non-union men. A union man takes his work seriously because he looks upon it as his life work. That can be explained by the fact that he contributes to the welfare of his union and looks to it to secure his livelihood at all times. It makes him content to stick to his line. Non-union men generally shift to other forms of employment if things do not go well with them.

Apart from competence, projectionists can also save the exhibitor quite a lot of money by careful handling of the equipment and economy in the using and buying of replacement parts. Careful care of the mechanism for example gives it longer life between repairs—and mechanism repairs are costly.

We all know how expensive power tubes, photoelectric cells and exciter lamps are. In these alone the projectionists can effect considerable saving for the exhibitor by exercising a careful supervision and by using them until they actually begin to impair the effectiveness of sound volume and quality. I had a very concrete example of this last only recently. My expenses for the above items were rather heavy and frequent. I looked into this and found that the service engineer had in each case ordered these replacements. The next time a requisition came through I bought new tubes but took the old ones to a laboratory for a test. I found that every tube had almost unimpaired power and could have done useful work for a long time to come.

Not long after that I had occasion to replace one of the men in the projection room and I asked the union to give me someone who was conscientious and reliable. I had a talk with him before he reported for work and explained the situation of the tubes to him. I asked him to check the service engineer carefully every time new replacements were ordered. I asked him to convince himself thoroughly that replacements were really necessary before he came to me.

I then noticed that such replacements were asked for at much longer intervals. I might say that at the suggestion of this same projectionist I began to purchase a different kind of tube. It cost much less and gave every bit as good service.

The ultimate test was that I detected no lessening in the quality of the sound reproduction. Things were every bit as good as before.

That was a man after my own heart. That was cooperation de luxe.

Cooperation isn't just a word. It means a saving of many dollars to me. Let us have more of it.

Academy Elections

Vice-president of the Academy of Motion Picture Arts and Sciences for the past three years, Conrad Nagel was elected president of the film body for 1932-33 at a meeting of the board of directors.

Benjamin Glazer, screen author, was chosen to succeed Mr. Nagel as vice-president, and Fred Niblo, secretary; Frank Lloyd, treasurer, and Lester Cowan, executive secretary, were re-elected.

The Academy's new officers will be installed at the organization's awards of merit banquet on November 18, at which annual awards for outstanding achievements in the motion picture professions are presented.

The board of directors of the Academy for 1932-33, consists of:

Actors: Lawrence Grant, Conrad Nagel and Sam Hardy. Directors: Donald Crisp, Frank Capra and John Cromwell. Producers: Irving G. Thalberg, B. P. Schulberg and M. C. Levee. Technicians: Karl Struss, Max Ree and J. Theodore Reed. Writers: Al Cohn, Benjamin Glazer and Oliver H. P. Garrett.

Don't Blame the Projectionist

By CHARLES CARWELL

We print the letter that follows because it touches on a phase of projection never hitherto discussed. The range of interest of the projectionist in his work is very evidently increasing and perhaps the time is not far off when no theatre will be able to foist upon the public a picture of the type here discussed without a very strong protest from the projectionists placed upon the record. As Mr. Carwell states, the projectionist is often made the "goat" though he is utterly blameless.—EDITORS NOTE.

Editor
MOTION PICTURE PROJECTIONIST.

I am a projectionist operating in a city not far from New York. Recently my wife and I took a few days off for a holiday in New York. One of our diversions was a "movie." It was a double feature, one an American picture and the other an English picture. We all enjoyed the American picture very much. It is really one of the best that has come out of Hollywood for a long time. But the English picture,—well I was ashamed of it. It is a pity that any theatre permits itself to play such pictures at all.

I am going to give you the title of the film and the theatre where I saw it. But please do not mention either because I do not wish to make an issue out of this nor cause the projectionists there any undue trouble, since they were wholly blameless and the fault is entirely the theatre's—or the theatre circuit because this theatre belongs to a chain.

(Editor's Note: The name of the theatre and the name of the picture have been eliminated at Mr. Carwell's request.)

The English picture was taken from an English book that came out a few years ago. I understand that it was a very fine book and was a good seller. From some of the scenes in the picture I should judge that it could have been made into a great film. It is a picture of simple people and their daily lives and their labors are almost folk lore.

The titles were duly thrown on the screen and we waited for the opening scenes. These came—and horrors of horrors—in this day of perfect audibility—all we could hear was a mumbling and a murmur. The people on the screen swallowed their words before they were even spoken. We couldn't distinguish a single word. For all that it mattered they were just performing to amuse themselves and not us.

The whole audience set up a howl. You know—the usual handclapping when an audience is annoyed and irritated by some failure of the picture. But the picture went right on just as if it was inevitable that it should be shown on the screen at this time and just in this way and nothing in the world could stop it.

Well, we suffered an hour of this to the last foot of the last reel.

There were some very pathetic parts in the picture. But did audience sit quietly through these scenes. Did it feel the pain of these scenes? It did not. On the contrary, we couldn't help laughing, the whole thing was so funny. Burst after burst of laughter rang through the theatre every time a particularly sad scene came on. That is a very natural reaction of any audience when it has been annoyed by a particularly bad picture or bad presentation of it. It just can't take anything about it very seriously after that.

Audience Annoyed

And the audience felt very much insulted. In the first place many of them had shopped around and selected this particular theatre for their evening's amusement. They had come to see as intelligent a picture as they would expect elsewhere. And having laid their good money down at the box office they were treated to this piece of mumbo-jumbo.

How can any film booker be so crude as to book any picture so unintelligible as this one? Didn't he screen it for himself first? Didn't he know something about its poor sound reproduction before he sent it to the theatre?

Anyway, the point I want to bring out is that while it had dialogue none of it could be understood. And the first thought was that it was the fault of the reproducer—that the projectionists weren't on the job. I have no doubt in my mind that the audience as a whole blamed the projectionists. Naturally they would. The average movie-goer doesn't know and wouldn't understand all the factors that go into making of a sound picture. He wouldn't know that what he didn't hear might be due to a failure in the recording apparatus or the inexpertness of the recorders and not the failure of the reproducer or the inexpertness of the projectionists. And so the blame is put where it doesn't belong and a great injustice is done.

No Their Fault

To assure myself that it was the failure of the recording—as I suspected from the very beginning—I left my seat and went up to the projection room. I introduced myself to the projectionists and told them why I had come up. They were very bitter about the mess—for that's what it was. But what could they do? They couldn't correct the fault of the recording and the picture had been given to them to play as part of the program. I learned that they had immediately protested to the manager and no doubt he had passed word right along to the circuit's office. But the picture had been on for several days already and no doubt would go through to the bitter end.

It's a shame! With the art of recording and reproducing so far advanced it's nothing short of disgraceful to throw a picture like that on the screen. It's an imposition on the audience which had paid to be properly entertained and not to be made a fool of. It was a shame to make good projectionists run such a picture and let them take the "rap."

I know that English pictures as a rule fall far short of even the ordinary American program pictures. I am not referring to story material. I am referring to technique. Even in the old days, before sound, English producers could not make pictures as well lighted or photographed as American producers did almost with their eyes shut. But now that sound is here they seem to be totally lost.

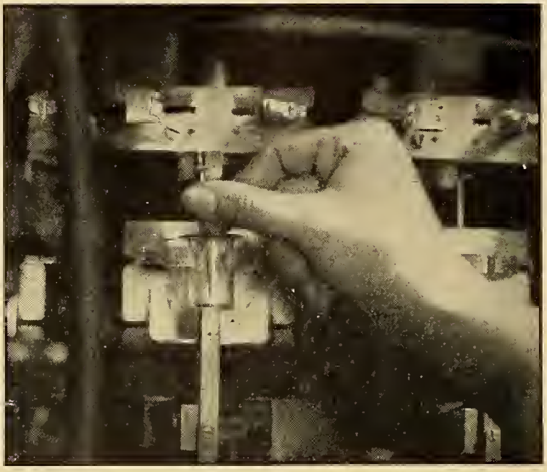
It is very difficult to understand that. Surely it is a simple thing to import American technicians to assist in the recording. And I understand that there are many American film technicians in Europe today associated with American offices over there, who might have been called in. As this particular picture was made on an American recorder I cannot see why some American personnel was not attached to it.

An American producer would have looked at the "rushes" of this picture and immediately junked what had already been made and started over again. He would have fired every one associated with it for incompetence. And at the end, if he had detected anything not quite so, he would have shelved the whole thing and written off his loss.

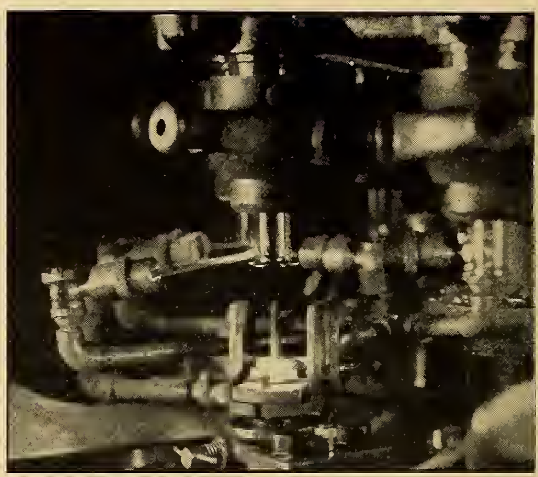
It is too bad there isn't some projectionist organization or agency that would be immediately apprised of such a picture and steps taken to advise the distributor that it should be taken off the screen. Projectionists all over the country will be blamed for poor work. They should be saved from this unjust criticism.

Building the Vacuum Tube

By L. G. LESSIG*



Placing the mechanical supports and electrical connections into the flare



This machine shapes the molten glass, like butter, into perfect flares

THE age in which we live is vitally influenced by the thermionic vacuum tube. Without this device, the rapid strides which have been made in radio development would not have been possible. In a few short years, the radio tube has entered into our homes, offices, factories and laboratories as an integral and essential part of modern living.

To meet the demands and exacting needs of this vast field, unceasing development of tubes and continuous improvement of tube manufacturing equipment has been required. Automatic tube making machinery has been developed to the stage where it now enters into practically every phase of our manufacturing activities. Such equipment is particularly well adapted for producing large quantities of tubes uniform in characteristics.

In attaining this uniformity, each component part of the tube structure must be precise in dimensions and free from impurities.

It is interesting to know that before any metal enters into the construction of a tube, it must be thoroughly cleaned. This is accomplished by heating the metal at a high temperature in an atmosphere of hydrogen. The process cleans the most tarnished metal.

Many of the parts are gauged to thousandths of an inch. Some parts require very much greater accuracy. The constituent materials of these parts are used only after they have passed exacting chemical tests. The need for this care may be appreciated when it is known that the active coating on some filaments weighs as little as 21 ten-millionths of a pound.

The same care which is used in the selection of individual parts is representative of the general manufacturing procedure for each type. Of these types, the '24-A is an excellent example for explaining the details of tube manufacture.

Making the Flare

The initial step in the process consists in the making of the flare. The flare is the interior glass section through which passes the connecting wires from the bulb interior to the base pins of the completed radio tube. Standard lengths of glass tubing are fed into a machine which grips each one and moves it through a series of gas flames of increasing intensity. When the lower end assumes a bright yellow color (at this temperature the glass is about as soft as warm wax) a whirling cone rises to gently shape the molten edge of the tubing into a flange or flare. After the operation has been completed, the machine transports the flanged tubing through additional gas flames which play upon it at a point to give the correct length for the finished flare. A rotating glass cutter swings down into place under the tubing, then rises within it to cut off the section at the heated portion.

After inspection, the flare is sent to the stem machine. The flare is placed in the stem machine where the wire supports and connections are inserted. Correct spacing between wires is insured by a metal form which holds them in the proper position to be sealed into the glass. Each wire consists of three sections welded together into a unit. The sections consist of nickel and copper with a small length of special metal called *dumet* fused between them at a point where the molten glass is pressed about the wire.

When the wires have been inserted within the flare, a length of glass exhaust tubing is automatically lowered into the center of this assembly. The flare arrangement is then carried progressively through flames which play upon it and melt it at a point where the glass is to be pressed together. Metal jaws firmly squeeze the glass around the wires, thus fusing the parts together in an air-tight seal or press. The assembly then moves into position under an air jet which supplies compressed air to the exhaust tubing in order to blow a hole through the hot soft glass below the pinch. It is through this opening that the bulb is evacuated in a later operation. The entire part, known as the stem, is removed from the machine and annealed to prevent glass strains. After inspection, the annealed stem is sent to the stem-forming machine, where the wires are bent to the proper shape to take the parts to be mounted thereon.

Mounting the Elements

After a careful inspection has been made, the stem is ready for the fitting of the additional parts, such as the plate, cathode, grid and screen. These parts are formed with accuracy by automatic machinery which operates more rapidly than the eye can follow. As these parts are mounted, they are electrically welded to insure permanent construction. First, the plate is mounted and welded to its respective supports. The grid and screen are next fastened in their positions. The outer section of the screen consists of a nickel mesh cylinder, while the inner section is a helical coil of fine wire. These sections are connected and held together at the top by a metal disc. The cathode is then inserted and welded to the proper terminals. The cathode consists of a heater wire enclosed in a metal sleeve from which it is electrically insulated. Great care is exerted in applying the active material to maintain exactness of coated area and thickness. After the sleeves have been sprayed, they are baked and carefully inspected.

---

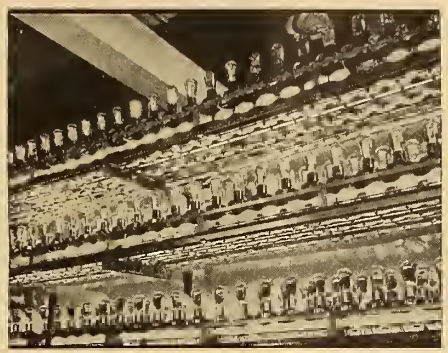
*E. T. Cunningham, Inc.

Here the parts are skillfully assembled on the stems

Exhausting the Gases

Following the grid assembly operation, the connecting wire which later is passed through the top of the glass bulb to the metal cap outside, is welded to the control grid support. The "getter" cup, the familiar little piece of metal, more like a tiny saucer, which contains pellets of magnesium, is then fastened to the grid support.

The unit, composed of a stem and attached parts, is known as the mount. It is inspected, tested for short circuits and transferred to the sealing-in and exhaust machine. Here it is placed on a rotating support, known as the sealing head, and a glass bulb is lowered over it. Heat is applied both to the junction of the flare and bulb. The sealing head, constantly rotating, moves the tube into increasingly hotter zones where the glass is softened by the fires. The glass around the control grid lead is sealed immediately after the flare and bulb junction is made. The entire glass bulb is annealed in the process after which the tube is transferred to the exhaust section of the machine where it is connected to the exhaust pumps. The atmosphere is drawn from the bulb in successive operations. To insure a more complete exhaust, the principal metal parts of the tube are heated by powerful high-frequency currents induced by an external coil that automatically drops around the bulb. The intense heat, created in the metal by induction, frees the glass and metallic tube parts of occluded gases which are immediately removed from the bulb by the exhaust pumps. The getter is flashed or vaporized after the exhaust is nearly completed. The flashing is accomplished by means of induction from a movable high-frequency coil which is dropped down around the outside of the glass bulb. The current induced in the getter cup is great enough to provide the necessary heat to vaporize the getter. The vapor absorbs residual detrimental gases to make a better exhaust, and condenses in a silvery film on the inside of the glass bulb. This condensation acts as a vacuum keeper during the useful life of the tube. When the exhaust process has been completed, the tube is automatically sealed off, disconnected from the vacuum pump and transferred by belt to the basing machine.



Seasoning racks where tubes are "tempered" for stabilizaztion of characteristics

Here the connection wires of the tube are properly threaded into the five pins of the base. The tube and base are passed through an oven, which hardens the cement on the inside edge of the base, thus fastening the bulb firmly to the base. Following the basing operation, projecting ends of the wires are cut off flush with the ends of the pins and soldered. A small metal cap is secured to the top of the bulb by means of cement and soldered to the grid lead.

Spraying the cathodes

The tube is once more examined for short and open circuits and then placed on a "seasoning rack" where voltages are applied to the electrodes. The tube is allowed to "season" for a length of time sufficient for its characteristics to become stabilized.

After the tube is seasoned, it is again tested for short and open circuits as well as for plate current, cathode activity (emission), a-c output, gas and leakage. On some types of tubes additional tests are made. Extremely accurate instruments are used for these tests. The completed and inspected product is finally wrapped in a corrugated holder and packed in its distinctive carton, ready for delivery to the purchaser.

From beginning to end, this brief story of one type of tube is indicative of the manufacturing skill, pains-taking care and precision processes employed in making each vacuum tube.

A Handbook on Carbons

SELDOM does a company issue gratis, a handbook so full of up-to-the-minute information, so interestingly written and co completely illustrated as is the new edition of the National Carbon Company's handbook on projection carbons. This new handbook has been written specially for the projection room, but contains information of interest to all users and also to manufacturers of carbon arc projection equipment.

The first chapter of the book is an informative resume of the different steps in the manufacture of the projector carbon. Several of the sections that follow are devoted to a discussion of the carbon arc in general, and to different types of lamps. The various types and sizes of carbons for projection are covered in detail, with complete tables and instructions for their proper use. Important operating precautions are discussed, with illustrations, showing the difficulties encountered when carbons are not used properly. A clear explanation of what is to be done to overcome difficulties, accompanies each case. The book also contains a useful chapter on carbon brushes and their application to the various types of motors, generators and converters employed in projection installations.

A copy of this new book may be obtained by addressing your inquiry to National Carbon Company, Inc., Carbon Sales Division, P. O. Box 400, Cleveland, Ohio. If you are a projectionist, it is requested that the name of the theatre in which you are employed be included in your letter.

Four Inventors

While most improvements in projection equipment come today from the experimental departments of large organizations, the latter are by no means the only sources of inventive genius in this field. Typical evidence of this is a recent report from Salt Lake City that four local projectionists, Eldon Brimhall, Donald Gabbot, Ellis Henrie and Waldo Nelson, have been granted a patent on a shutter device. The invention is designed for automatic fire control, and can be attached to all makes of projection equipment.

There is abundant evidence that projectionists have contributed greatly to the advancement of projection. Some of them have even turned to selling their own inventions to the industry and a few of them have been markedly successful.

Filters for Projection Equipment

Research Department, Aerovox Corporation

IN the article on page 28 of the October issue of THE MOTION PICTURE PROJECTIONIST, entitled "Power Conversion," mention is made of the use of Electrolytic Condensers as Filters for the low voltage supply to exciter lamps and vacuum tube filaments in Sound Picture installations in Theatres.

As noted in the previous article, the Electrolytic Condensers provide a satisfactory method of preventing background hum, due to the use of low voltage direct current from a motor-generator, for furnishing power to the exciter lamp. The Electrolytic Condensers are also used in conjunction with choke coils, filtering the supply from a motor-generator to the filaments of the vacuum tubes in the head amplifier, and main amplifier.

If a motor-generator is properly designed, an Electrolytic Condenser of about 2,000 mfd. or 4,000 mfd. capacity is all that is required as a filter for the exciter lamp. The supply to the filaments of the vacuum tubes in the head amplifier should be fed through a more complete system. This filter system should include a 2,000 or 4,000 mfd. Electrolytic Condenser, connected across the terminals of the machine, a choke coil in each supply line, and another Electrolytic Condenser across the line on the load side of the choke.

The arrangements used in an actual installation for furnishing low voltage D.C. from the motor-generator to horn fields, exciter lamps, head amplifier filaments and main amplifier filaments, are described in the article "Power Conversion," mentioned above.

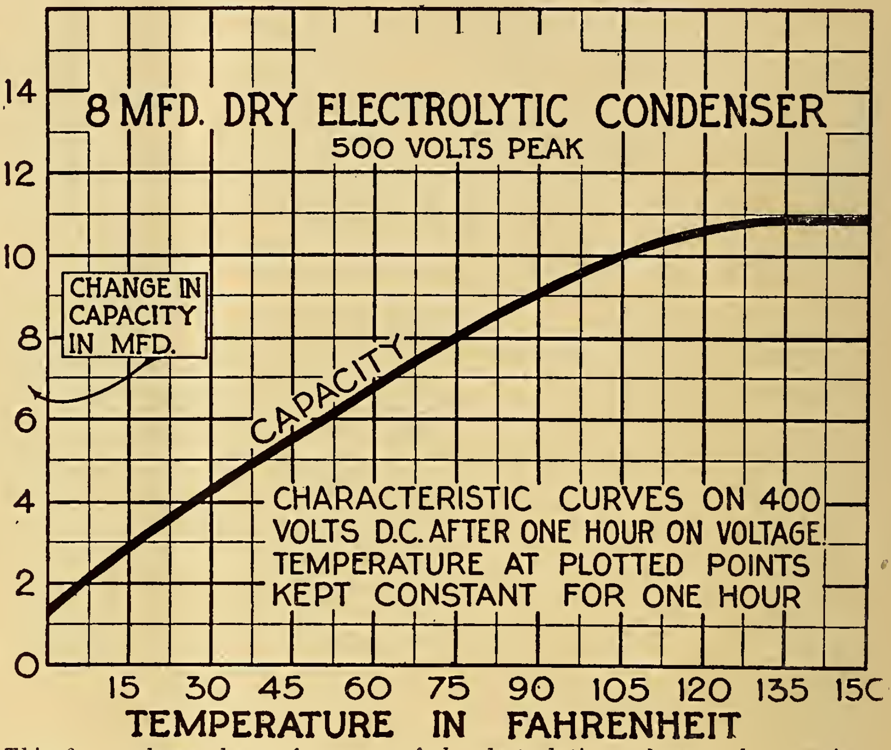
Advantages

The Electrolytic Condensers are much more satisfactory than any other type for a number of reasons, discussed below, the most important of which is their small size, low cost and reliability, when furnished in the larger capacities referred to above.

The Dry Electrolytic Condenser is referred to as "dry" to indicate that it contains no unabsorbed electrolyte. Such construction eliminates any possibility of leakage of the electrolyte. The general use of this type of filter condenser is due to a number of factors of which the following are probably the most important.

The first advantage, and in these days a most important one, is its low cost. An electrolytic condenser costs a manufacturer about one-sixth as much as a paper condenser of the same rating.

A second advantage is compactness and light weight. For a given voltage and capacity the electrolytic condenser requires a comparatively small amount of space.



This figure shows the performance of the electrolytic condenser when continuously subjected to temperatures as high as 150° F.

A third advantage is the ability to accurately predetermine the maximum voltage the condenser will withstand.

The fourth advantage is its comparative immunity to voltage surges in excess of its rated peak voltage.

Dielectric Properties

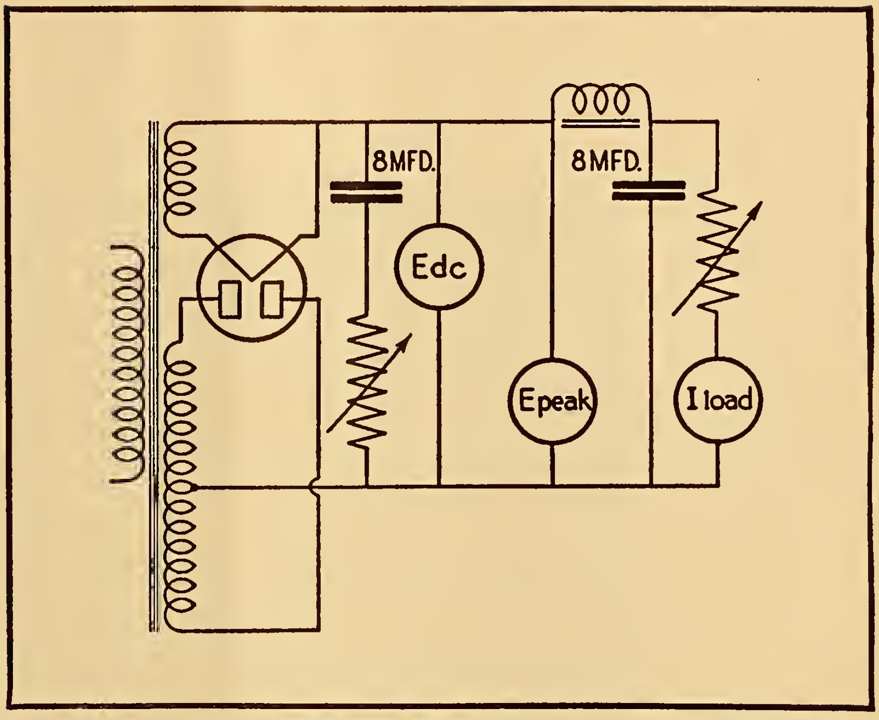
These valuable properties are primarily due to the fact that the electrolytic condenser incorporates an extremely thin film formed electro-chemically, usually on the surface of the anode. Its exact thickness has not been accurately determined, in the case of a 500 volt condenser, it is from hundred thousandth to one millionth of an inch thick.

The film formed on a smooth clean surface is transparent. Due to light interference effect, however, the film may sometimes appear to be tinged faintly red, yellow, green or blue, depending upon its thickness. The great di-electric strength of the film enables it to withstand high voltages, and it is possible to secure high capacities per unit area. On an average, each square inch gives a capacity of approximately 0.06 mfd.

These dielectric properties of the film are effective only as long as a positive potential is applied to the anode. Should the polarity be reversed the film will not oppose the flow of current and the unit ceases to function as a condenser. Hence the ordinary electrolytic condenser can be subjected only to uni-directional currents; they are not suitable in circuits with straight alternating currents, and in general where reversal of the polarity occurs.

Withstands Voltage Surges

During manufacture, the film on the anode is formed to a certain definite voltage and electrolytic condensers will operate safely on all voltages not exceeding the forming voltage. As the forming voltage can be accurately controlled during manufacture, it means that the engineer, knowing the peak voltage can purchase filter condensers that will safely withstand the peak voltages. The maximum voltage to which a condenser can be formed depends upon the characteristics of the electrolyte. The condensers used in theatre sound installations are usually formed at 24 volts. This allows an ample safety factor as the generator seldom delivers more than 18 volts. With paper condensers over-voltages may cause permanent breakdown of the condenser. However, should momentary over-voltages be applied to the electrolytic condensers its film gives way while the surge lasts, but as soon as the excessive strain is over the film is restored for it is an oxide which is rapidly produced by the electrochemical action of the leakage current itself; in this way the condenser almost immediately regains its normal operating characteristics. Excessive voltages do not, therefore, destroy permanently the dielectric layer and this characteristic makes the condenser immune to ordinary surges.



Wiring Diagram of Circuit used in tests of electrolytic condensers.

Design

Essentially the electrolytic condenser consists of:

1. The anode, an aluminum foil.
2. The oxide film, formed electrochemically on the surface of the anode; this film is the dielectric of the condenser.
3. The electrolyte, which is the cathode proper.
4. Several layers of gauze saturated with the electrolyte.
5. The second metallic electrode which forms the cathode terminal.

The capacity effect may be considered to be produced between the surfaces of the anode and the electrolyte and is due to the film between them. The electrolyte establishes an intimate contact with the film and the second metallic electrode is in effect an extension of the electrolyte.

It should be pointed out, however, that this theory of operation is not universally accepted, some engineers, believing that the unit functions because of a thin layer of gas on the surface of the anode. The opinion has also been expressed that a cell consisting of two aluminum electrodes with an electrolyte which does not attack aluminum is really not an electrolytic condenser but a true electrostatic condenser in which the film of aluminum is the dielectric.

Performance Characteristic

In considering the performance of the dry electrolytic condenser, the following factors of importance:

1. Life.
2. Maintenance of capacity.
3. Normal leakage current.
4. Leakage current after periods of idleness.
5. Ability to operate over wide ranges in temperature.
6. Efficiency in filter circuits.

Condensers of this type have been tested under all conditions of humidity, temperature and voltage. In some tests only d.c. was applied, in other tests 120 cycle or 60 cycle voltages were superimposed on the d.c. voltage. In general the test conditions have been much more severe than those to which the condenser will be subjected in practice.

For a constant anode area, the capacity obtained is approximately inversely proportional to the formation voltage. With our electrolyte, a total formed anode surface of 156 square inches gives a capacity of 8 mfds. when the unit is formed at 500 volts; if the formation voltage is 250, then the same anode area gives a capacity of 16 mfds.

Maintains Characteristics

Since the capacity depends upon the formation voltage, the question naturally arises of the effect which occurs when a unit formed to a certain voltage is operated on a lower voltage. Experience has indicated that under such conditions the capacity gradually increases if the unit is operated on a voltage lower than the original forming voltage. The change in capacity takes place very slowly, however. To check this point, an 8 mfd. 500 volt condenser was placed across a 45 volt circuit. The unit had an initial capacity of 8 mfds. After operation for three thousand hours at 45 volts, the capacity increased to 13 mfds. This represents the etxreme condition since the operating voltage was only one-tenth of the initial forming voltage. We can conclude, therefore, that when units are operated at voltages somewhat lower than the forming voltage, the capacity will increase very slowly, and that no considerable change in capacity will occur over an operating period of several thousand hours.

In the test described, the condenser was actually used as a by-pass across a C-bias resistance in a receiver. The current in the circuit was quite limited, being about one mA and this test can therefore also be taken to show that this electrolytic condenser maintains its capacity even when the d.c. current is very limited. We have received a number of inquiries from engineers who consider that if an electrolytic condenser is used as a by-pass in circuits where the current available for maintaining formation is limited to about one mil., that the unit would gradually deform and cease to act as a condenser. This test showed that such an effect does not occur, that the condenser maintains its characteristics even when the available current is etremely small.

Effect of Temperature

It is obvious that if an electrolytic condenser is to give satisfactory service it must be able to withstand both high and low temperatures. The test specifications of many companies include tests at 140 degrees F. with superimposed a.c. and d.c. The condenser gives excellent performance when continuously subjected to such temperatures.

At room temperature, 75 degrees, the condensers under test have an average capacity of 8 mfds. Temperatures above this value cause an increase in capacity and temperatures below 75 degrees cause a decrease in capacity; this is characteristic of all types of condensers which we have tested. It is important to note, however, that the condenser remains operative down below zero degrees F. due to the fact that electrolyte used has a very low freezing point. Subjecting condensers to temperatures below zero F. and then allowing them to return to room temperature has shown that these low temperatures have no prmaenent effect on th condenser characteristic.

Efficiency In Filter Circuits

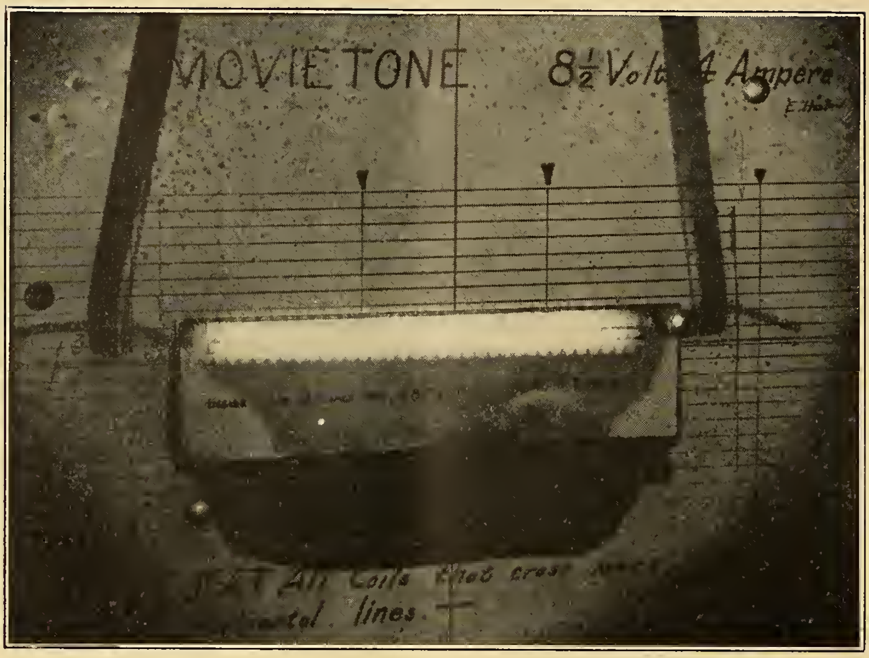
The following data have been obtained from a number of measurements on filter circuits using electrolytic condensers. These data will show that in filtering action the electrolytic condenser is essentially equal in every respect to a paper condenser of the same capacity.

In the course of research on electrolytic condensers units of various power factors were constructed and it was found that as the power factor is reduced by suitably altering the electrolyte that the tendency for corrosion to take place is increased. Considerations of corrosion make it desirable therefore not to produce condensers

(*Continued on Page* 25)

An Important Little Lamp

By R. E. FARNHAM*



As a final step in its manufacture, the exciter lamp is placed in a precisioon optical gauge, and the small black rectangle on the chart (which represents an area .005 inches wide) must come within the solid part of the source.

THE photocell exciter lamp occupies that unfortunate position of being completely forgotten when all is well; but let a slight hum or a stray tinkle creep into the sound as it comes from the horn back of the screen and this little lamp is forthwith blamed. Happily, further investigation almost invariably gives the lamp a clean bill of health.

When one realizes all the transformations—magnetic, electrical, photographic and mechanical — through which the sound vibrations must go from the time they originate until they reach the theatre audience, he can appreciate the careful design and excellent workmanship embodied in the modern talking picture equipment now used in almost every theatre. However, most projectionists are inclined to look upon the photocell lamp as just another lamp, a hair-pin-in-a-bottle, no different from a reading lamp at home. It may come as a surprise to some projectionists to know that the photocell exciter lamp has been given every bit as much study and thought in its design and as much care and precision in its manufacture as any other part of the sound equipment.

The Lamp and Its Use

The function of this lamp and its associated optical system is to place a bar of light about .085 inches long and .001 inches wide on the sound track of the moving film. The brighter this bar of light is, the less the amount of amplification necessary to obtain the requisite volume of sound.

The most practical way of obtaining a bar of light of these dimensions is to place an aperture, usually somewhat larger than the spot of light required, but of the same proportions, within the optical system and to image this slit onto the film by means of a lens. To illuminate this aperture uniformly to maximum brightness, the filament of the photocell exciter lamp is imaged near the aperture plate by means of a condensing lens. The design of the condensing lens is such as to permit placing the lamp filament close to the condenser so as to utilizze as much of the light flux from the lamp as possible. For this reason, tubular bulbs are used rather than the spherical or other more famaliar shapes with their greater filament-bulb spacing.

Optical systems which employ the 8.5-volt 4-ampere lamp make use of a section of the lamp filament approximately .3 inches long and less than .005 inches wide. In order to present a uniform and solid mass of luminous area, the filament wire of this lamp has been coiled in such a way that the back half of the turns cover the gaps between the front side of the turns. To compensate for slight variations from a true straight line or a slight tilt in the coil, this solid band of light is actually made 10 to 15 thousandths of an inch wide.

When any coiled filament lamp is lighted, a slight expansion of the coil takes place, and unless provision is made in the design of the lamp, the coil will sag and move the center part of the filament out of alignment with the optical axis. This is prevented by making two little flat sections in the leading-in wires just above the stem seal. These give a degree of springiness to the support wires which keeps the filament taut and straight.

The 7.5 and 5-ampere 10-volt photocell lamps are designed for an optical system which incorporates a cylindrical element in the condenser lens. This cylindrical surface spreads out horizontally the image of the light source of these lamps at the aperture without affecting the image in a vertical plane. Thus it is possible to use a shorter coil of larger diameter. The 7.5 and 5 ampere lamps are interchangeable, and whether to use one or the other depends on th recommendations of the service engineer. Power supply and control rheostat are considerations that affect the choice of the two lamps. These lamps are, of course, not interchangeable with the 8.5 volt 4 ampere lamp because of differences in the optical system of the reproducer sound head.

Current to Use

There has been considerable discussion concerning the current at which these lamps must be operated. Probably the best rule is to accept the recommendation of the manufacturer of the sound equipment or his service engineer and not depart from it. From the design of his reproducer and the type of photoelectric cell, the manufacturer knows the exciter lamp current that gives the best results.

If the photocell lamp is operated at a current much in excess of this recommended value, a "hiss" may develop in the sound output; if the lamp is operated under current, it is necessary to advance the gain control to such a point that the background noise becomes objectionable. If the current

(*Continued on Page* 32)

G. E. Nela Park Engineering Dept.

HOW TO "SHOOT" TROUBLES ON YOUR PROJECTION EQUIPMENT

BUY READ and USE

SERVICING PROJECTION EQUIPMENT

451 ORDERS RECEIVED FOR THIS BOOK AS A RESULT OF THIS ADVERTISEMENT IN LAST MONTH'S ISSUE.

ORDER YOUR BOOK TODAY

A very useful book, designed and written only for the motion picture projectionist . . . as handy and as necessary as any tool . . . already many hundreds of copies are working over-time in as many projection rooms.

This book can be had today for $1.00. There are no strings attached to this unusual offer. We pay all postage.

Get your copy at once. Fill in your name and address in the coupon below, pin a dollar bill to it, insert in enveope and mail to the Mancall Publishing Corp.

Published by
MANCALL PUBLISHING CORP.
7 W. 44th STREET
NEW YORK CITY

CUT OUT - FILL IN - MAIL AT ONCE

Servicing Projection Equipment

Last Copies

$1.00 Only

Name ....

Street ....

City ....

State ....

An Explanation of Current Flow

By ROBERT J. MARCY

This is the first of a series by Mr. Marcy. The writer will continue his talks in coming issues and will be glad to discuss any questions that may be suggested by projectionists.

THE projectionist wishing to understand the working of sound equipment, must first acquire a comprehensive understanding of the electrical principles involved. Since the coming of talking pictures, there have been available to the projectionist many excellent discussions on electricity and sound. In many cases, however, their writers have been inclined either to take definitions for granted or to treat them in accepted academic terms which have little meaning for the average projectionist. It is intended in this article to touch on some of these definitions and give a brief, but it is hoped clearer explanation of their meaninig than is usually to be found.

Chief among these definitions is that of *current flow.* Current flow is the movement of a quantity of electrical energy from one point to another.

Amperage is the measure of the quantity of electrical energy just as quarts per minute is the measure of water flowing through a pipe. To say that one ampere of current is the amount of electricity which one volt will push through one ohm of resistance or to go farther back and define it as the amount of electricity which will plate a certain quantity of silver on a certain object under certain conditions, is unnecessary. Likewise, it is better to define voltage as the pressure or push necessary to force electricity through a circuit rather than as the amount of pressure which will force one ampere of electricity through one ohm of resistance, or by a definition even more fundamental and absolute. To continue our analogy, of the water pipe, the volt corresponds to pounds per square inch of water pressure. The ohm is the unit of resistance just as the friction of the water against the pipe is the resistance holding back the water from free flow through the pipe.

To understand the flow of electrical energy, we must first have some understanding of the electronic theory as it is upon this theory that the explanation of current flow is based.

The *electron* is the particle of negative electricity. This is the smallest individual unit of matter known to scientists today. The *proton* is similar to the electron except that it is a positive instead of a negative charge. All matter, everything that exists, is made up of *atoms,* usually in definitely constructed groups called *molecules.* Each atom consists of two quite different constituents, the relatively small positive charge of electricity or proton which is the nucleus or center point, and one or more negative charges of electricity or electrons. The electrons always surround the proton. When the atom is at rest, or is neutral, it has a sufficient number of electrons (negative) to balance the proton charge (positive). However, it sometimes happens that the electrons leave the nucleus or proton and travel. Since the electrons are at the surface of the atom and are held together by the balance of positive and negative charges within the atom, it is relatively easy to set electrons in motion by either mechanical or electrical force. When the experiment of producing static electricity by friction is performed, a test will show that for a positive reaction to the object being rubbed there is an opposite and negative reaction in the cloth being used. In other words, electrons are being rubbed from the stick onto the cloth so that the stick having atoms with one or more negative electrons rubbed off is now unbalanced, with a surplus of positive electricity. The cloth on the other hand, with loose negative electrons in suspension has a negative reaction. If the cloth and the stick are again brought into contact, the loose electrons will leave the cloth and go back to their respective atoms again forming a balanced or neutral state.

When a source of electrical pressure or *electromotive force* (*e.m.f.*) such as battery or generator, is introduced into a circuit and the ends of the circuit are closed there is created a state of electronic unbalance. At the positive terminal of the source of e.m.f. negative electrons in the circuit are attracted by the surplus of positive electricity. This in turn creates a state of unbalance within the circuit itself. As is the case in any circuit, the electrons within the circuit attempt to restore the balance and draw upon the negative source of the e.m.f. for more particles of negative electricity. This flow of electrons from the positive to the negative source, creates current flow within the circuit as long as the circuit remains closed.

SUN-ARC CARBONS

FOR

PERFECT PROJECTION

"Best by Test"

BIG SAVING—COMPLETE SATISFACTION

BETTER LIGHT—SLOWER BURNING

CARBON SAVERS (Patent pending) free of charge

2 Savers for each Theatre. Burn Hilow and High Intensity down to 2 inches and less.

CARBONS FURNISHED READY FOR USE WITH THE SAVER. No inconvenience whatsoever for the operator.

HIGH INTENSITY CARBONS 13.6 are furnished 22 inches long.

Hi-Low Carbons (for 60-85 amps.) are precratered.

SAMPLES ON REQUEST

CARBON PRODUCTS, INC.

324 West 42nd Street New York City

A Glimpse Into the Future

By RAY KILGORE

THE theatre has not been exempt from experimentation. From the early days it has been subjected to all sorts of manhandling, but always with the greatest solicitude for its welfare. New forms have been tried and either adopted or discarded, as they proved themselves of value in heightening the dramatic art or not. From the time when the theatre first took embryonic shape to the present the actors, the scenery, the costumes, the stage, the auditorium—in short, every phase has passed under the eye and hand of the professional and amateur worker in the theatre.

Today the theatre has its revolving stages; it has quite often omitted its descending curtain and simply separates from the audience by blackness, the absence of all light. It has adopted the motion picture technique of black-out; it has changed its lighting system gradually until today it is a fine art; the actors have gone in for a realistic style in tune with the harsh, uncompromising times; these are but a few of the changes that have taken place.

But nowhere in the theatre is the attention and concentration given that is centered upon the advancement of the motion picture. It is in this field of the theatre—for the motion picture is and always will be theatre—that changes have taken place and swiftly. There is hardly a pause for breath in the work of perfecting this baby art. In half the lifetime of one man—Edison—it has grown from hesitating childhood to fullgrown and confident self-sufficiency.

The best minds have given it their undivided attention, both in the laboratory and in the studio. It engages the attention of financiers who have placed their millions back of it. It has attracted away the finest actors from the stage. It might, in time, be the death of the legitimate stage, or at best if the legitimate stage survives, it will appeal only to the bitter-ender, to the few who cling forever to outworn forms.

The motion picture races onward. It is dynamic, spirited and lusty with life. To millions of people daily, it is the escape from cruel reality and so long as it possesses this engaging quality it will be a living force.

It is to the motion picture that we must look for future changes in the dramatic art. What form will it take next year, what form will it have ten years from now, fifty years from today?

It is difficult to predict changes in technique. Certainly we are due to have a third dimension on the screen—depth. We will have color in its natural forms. The voice is already here and is approaching a casual naturalness. But are we always to see the picture in a theatre. Must we travel away from home and sit with thousands of others to enjoy it?

It is my opinion that the time is coming when the theatre will be transferred into the home. The development of radio broadcasting and television make this next step inevitable. How this will be accomplished may well be left to the engineers who must overcome certain obvious difficulties. When that is done, it is not far-fetched to envision every apartment possessing its radio and picture receiver as it now possesses steam heat and electric light.

Why not?

No European News

Mr. Sidney Kramer, one of our subscribers, writes in for a request for more information about projection from abroad. He asks to be referred to sources where such information is available.

Strangely enough that is a hard request to fill. There is really a lack of adequate information about this subject. One publication called *Film-Tecnik* is published in Germany but deals also with technical production matters and is moreover very technical reading. We do not know of any English journal devoted exclusively to projection matters although nearly every English motion picture trade paper prints projection news and discusses projection problems. Germany, which is the one country in Europe to even attempt to match America in recording apparatus, cameras, projectors and projection accessories, has, as mentioned above, one paper, but on the whole is much more interested in the technique of the camera than in ay other angle of motion pictures, outside of the fan interest, of course, which is as extensive there as it is here.

France, Italy and other countries offer very little at present. Russia is rapidly coming to the fore in film technique but it is all quite new and very little has penetrated into America and what has is still untranslated and therefore unavailable now.

American motion picture journals circulate in Europe quite extensively but we sadly lack some systematic exchange of information.

All Tycoons Gone

In the old days the leading figures on the business side of the motion picture industry were hailed as barons, tycoons, magnates, czars and whatnot. To a great extent such appelations were deserved. It all dates back before sound pictures and the subsequent invasion of the industry by new lords of finance, and the influx of a multitude of new writers and new players and directors as well as other hosts unknown and unrecognized before.

Those were the days when Adolph Zukor was the master of Paramount, and William Fox the over-lord of Fox Pictures. There were others equally great who developed and retained control of motion picture production and distribution. They were all mighty figures.

Today Mr. Zukor is admittedly not the power he once was. William Fox lost control of the gigantic company he founded. Of all those, Carl Laemmle is still in power and his company, Universal, has been least, if at all, affected by the changes of the last half a dozen years.

Today Western Electric dominates the motion picture business, in all branches, through its recorders and reproducers. RCA is also a big factor. Bankers sit in the inner councils of all the big companies and exercise controlling powers. Most of the old directors have passed out of Hollywood and the new names and faces are too numerous to recall. A new set of studio technicians has come to the fore.

The motion picture business is bigger and in many ways better. It still goes on but the changes are many.

DeVry Back

DeVry motion picture machines and cameras are now back in the hands of Herman A. DeVry, the originator of the line. All of the QRS-DeVry stock and equipment valued a few years ago in the millions, was included in the purchase. The new firm is called HERMAN A. DE VRY, INC., and concentrates on sound products. Among the new items of interest to the trade are the DeVry Sound Heads for Simplex and Powers machines—and for portables like Holmes and Acme. There is also The DeVry Portable Sound-On-Film outfit complete for schools and small theatres.

A New Recording System

By CECIL B. FOWLER

A GREATLY increased range of tonal reproduction; an increased dynamic range with the ability to reproduce sound shadings from the merest whisper to the full ensemble effects of the symphony orchestra; and virtual elimination of extraneous "ground" noises by a new system of eliminating the area on the sound track not actually utilized by the sound wave itself, are the principal improvements claimed for the new RCA Victor recording system.

This new "Hight Fidelity" system of sound-on-film motion picture recording was demonstrated recently before a group of trade paper editors and newspaper men gathered in the offices of the RCA Victor Company, at 411 Fifth Avenue, New York City.

By way of contrast, the demonstration was begun with the showing of a reel of film representative of the best reproduction of the early days of sound pictures. This was followed by a reel from a picture representing high present-day standards. Next, a Van Beuren cartoon subject recorded with the new "High Fidelity" system was run off. The demonstration concluded with a sound recording alone of Ravel's stirring "Bolero."

According to the RCA company, the new high fidelity system, reproducing as it does speech and music in a frequency range from 40 to 10,000 cycles, provides the widest range of reproduction ever available to a motion picture producer. Some idea of the extent of this range may be had, they say, when it is considered that the first sound film did not reproduce many frequencies clearly above 4,000 cycles, and that the one at present in use does not provide reproduction above 8,000 cycles. In terms of audible sound this means that the subtle overtones, reaching up to 10,0000 cycles, which give vitality and realistic timbre to speech and music are now faithfully reproduced.

The marked improvement in the quality of reproduction has been accomplished more by the improvement of every part of the recording equipment that by any single revolutionary step in method or design. To quote one of the RCA engineers, they have "worked from the ground up." A detailed description of each of these improvements is not possible within the limits of a single article, but it will be attempted to give here a comprehensive outline of the more important features of the High Fidelity recording equipment.

Extended Frequency Range

It is well known that one of the handicaps chiefly responsible for the "canned" quality of sound reproduction in moving pictures has been the limited frequency response of the units involved. In this respect the weak links in the chain which begins in the studio and ends in the theatre have until recently been, the microphone, the recorder optical system, the recorder film and the loudspeaker. The obvious omission of the projection equipment is made because we are concerned here mainly with the recorder. The loudspeaker is mentioned however, since it has been the chief cause of the loss of low frequencies in the past, and because it is known that there has been designed a loudspeaker employing a dynamic cone and directional baffle which has a frequency response from 60 to 10,000 cycles. This speaker is of the exponential type, 10 feet in length and has a mouth 75 inches square. The driving unit consists of a cone 6 inches in diameter. The frequency defects due to the microphone have been overcome by the design of the velocity microphone, which will be described fully in the next issue of this magazine.

The frequency losses caused by the film itself were due to limited film resolution, that is, inefficient photographic reproduction of the light variation of the recording beam. The resolving power of the film depends upon the film emulsion, the method of developing and printing, and the efficiency of the recorder optical system. The first two limiting factors have been minimized by a study of their chemistry, while the efficiency of the optical system has been increased by the use of a new galvanometer.

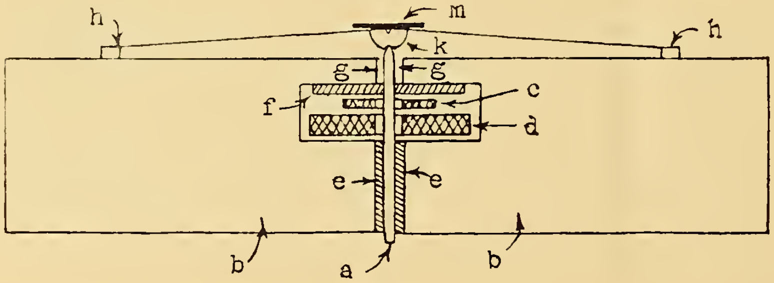


Fig. 1.

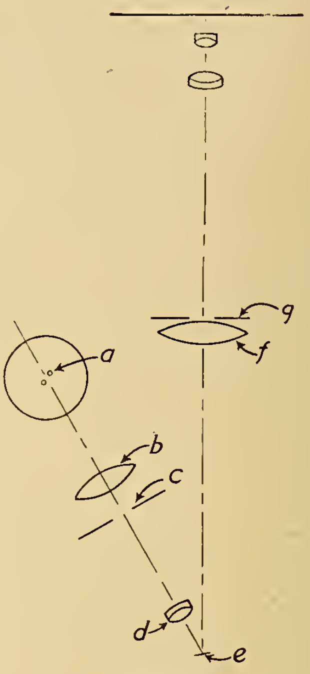


Fig. 2

Recording Galvanometer

Figure 1 shows the construction of the new dry, balanced armature type of recording galvanometer used in recording the high fidelity sound track.

The armature, a, is clamped between the two pole pieces, b, being separated from contact with them by the non-magnetic spacers, e. The lower half of the armature is therefore fixed, but the upper part is free to vibrate within the gap, g. The end of this part is ground to a knife edge to fit into a groove cut in the semi-cylindrical mirror plate, k. Between the plate and and the mirror, m, a phosphor bronze ribbon is cemented so that the three form a unit. The prongs, h, fastened to the ends of the ribbon, bear against the pole pieces in such a way that the ribbon exerts a downward vertical pressure which keeps the mirror plate bearing against the end of the armature. The coils, c, and d, surround the armature, but are not in contact with it. Coil c, carries the voice current from the recording amplifier, while coil d, wound with many turns of fine wire, carries a biasing current for the purpose of eliminating ground noise. A rubber pad f, provides the necessary damping at resonance, which occurs at 9,000 cycles. The interaction of the fields of the two coils and the field of the magnets imparts a whip action to the end of the armature. Since the stiffness of the ribbon prevents horizontal shifting, the movement of the armature results in a tilting motion of the mirror.

This galvanometer is much more

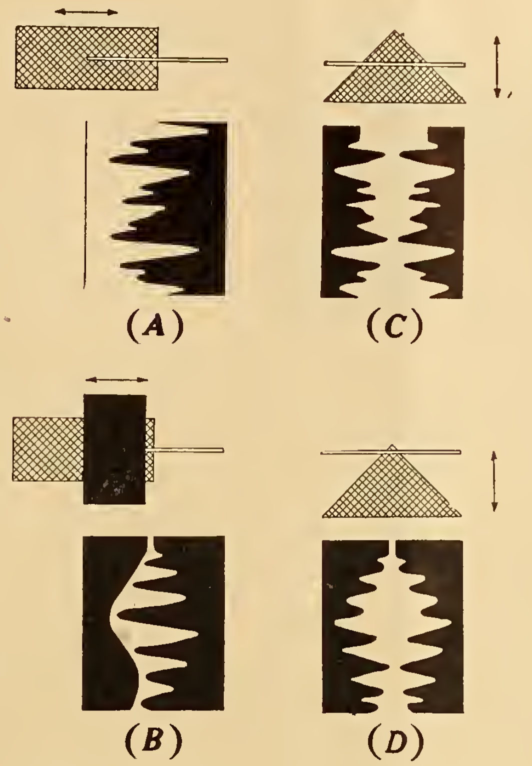


Fig. 3

efficient than those previously used. Its increased efficiency makes it possible to use a mirror 0.125 inch long by 0.100 inch wide, which is considerably larger than the mirror hitherto employed. This in turn results in less stray light and a better concentration on the film. The instrument is also easier to adjust and holds its adjustment better than the old galvanometers. Furthermore, its frequency characteristic varies less with temperature change than was the case with previous types.

Optical System

Figure 2 shows schematically the recording optical system of the recorder. Light from the recorder lamp, a, is collected by means of a condenser lens, b, and is brought to focus on the galvanometer mirror, e. A triangular aperture placed at c is focused by means of the corrected lens, d, upon the mechanical slit, g. A condenser lens, f, concentrates the light passing through the slit, g, to form an image of the mirror, e, upon the back lens of the microscope objective. The objective lens, in turn, forms an image of the slit upon the film. The galvanometer mirror vibrates about an axis parallel to the slit.

Light Slit and Frequency Limitation

Before going farther with this discussion, it is necessary to review what is meant by variable area sound recording. Figure 3 (A) illustrates the method of variable area recording first employed. The cross-hatched rectangle in the figure represents a cross-section of the light beam as it reaches the recording slit. The narrow unshaded rectangle is the slit itself. In its initial position, that is, when the galvanometer mirror is at rest or when modulation is zero, the light beam is half way across the slit. Were the beam to remain stationary while the film moved past the light slit, the sound track portion of the printed film would be half white and half black. As indicated by the double arrow in the figure, the light beam moves in both directions horizontally across the slit. As it moves to the right, the amount of light to which the film is exposed is increased. As it moves to the left or draws away from the slit, the light diminishes. The result of this vibrating motion, plus the motion of the film past the slit is the series of jagged peaks which compose the printed sound track. The variations in the height of these peaks—or more properly their *length* since they are horizontal—are the variations in the *volume* of the recorded sound. The *grouping* of the peaks represents the variations in *frequency*. Roughly speaking, the close grouping of the peaks are the record of high frequencies and those parts of the sound track where the groups are wide represent low frequencies. This, of course, is no different from the usual representation of a modulated wave except that looking at the film in its familiar position the theoretical base line of the wave is vertical It is necessary, however, to make this distinction between amplitude and frequency as represented on the variable area sound track, in order to explain clearly what follows.

The light beam as it comes through the slit to the film although very thin is of appreciable thickness with respect to the recorded wave. As the frequency rises, a point is approached where the wave length grows so short that it is less than this dimension of the light beam. It is evident that there can now be no demarcation of black and white since the area covered by the cross-section of the beam is itself entirely white. This will be seen better by referring to Figure 4.

Hitherto this limitation was not a serious one since that due to the film itself caused attenuatoin or thinning out of frequency considerably below the point at which it occurred.

However, to take full advantage of the added frequency range due to the increased resolving power of the film it was necessary to reduce the thickness of the light slit. This has been made possible by the use of a larger galvanometer mirror which results in a better concentration of the light beam.

Ground Noise and Dynamic Range

Referring again to the portion of the sound track shown in Figure 3-A, it will be seen that there is a white area on the left hand side into which the black outline of the peaks does not extend. Were it possible to make the clear portion of the film strictly transparent and keep it so, this surplus area would have no effect on the reproduced sound. However, the grain of the film, plus small scratches and particles of dirt on the film's surface, causes a myriad tiny shadows in the light beam from the exciter lamp. These, as is well known, are the chief cause of the rushing, crackling sound known as "ground noise.' '

The presence of ground noise has always been a serious limit to the dynamic range or possible volume of the reproduced sound, since in order to minimize the ground noise, it has been necessary to keep the volume of

This article has been adapted in part from the paper, "Extended Frequency Range," which appears in the November issue of the Journal of the Society of Motion Picture Engineers. It has been attempted here to give a somewhat fuller explanation of the more important features of the new recording system, with particular reference to the symmetrical sound track. Due to present lack of information concerning the latter, the comparison of the two types of sound track is more limited than was originally intended. It is hoped that it will be possible later to clear up some points regarding ground noise and the variable area system of recording which seem to us to be still open to discussion. C. B. F.

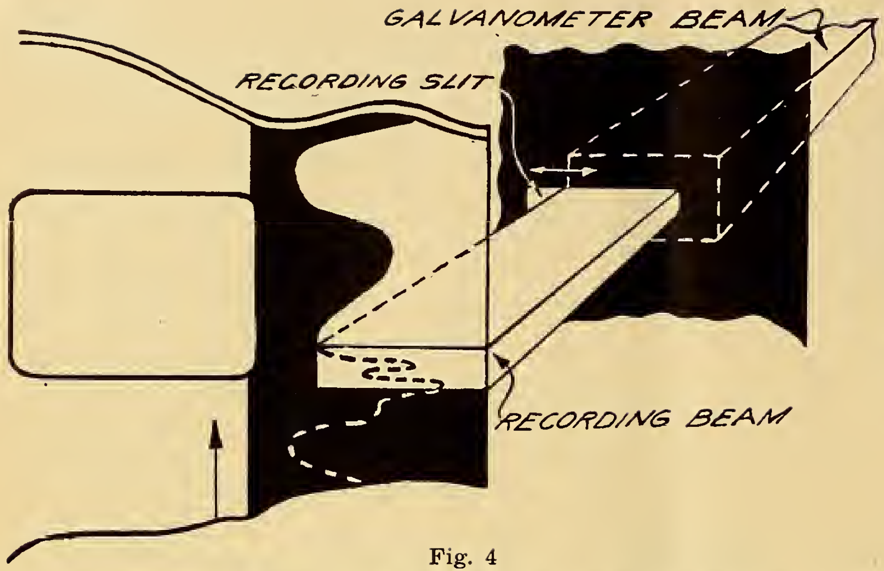


Fig. 4
Exaggerated view of sound track and recording beam showing how cut-off occurs when wave length becomes less than thickness of beam.

the wanted sound correspondingly low. It must be noted that the ground noise is much more noticeable at low volumes, for the extent of the margin representing unwanted sound is then greater in proportion than it is where higher amplitudes are recorded. Also, there is the masking effect depending on the nature of the reproduced sound. As examples, it may be said that ground noise will hardly be a factor in some part of the picture where three engines are rushing to put out a fire, nor will it be noticed in a scene with an accompaniment of a steady downpour of rain. On the other hand, it has been known to play considerable havoc with the pianissimo notes of a violin solo.

Figure 3-B illustrates the method at present in use to eliminate ground noise. Here a separate shutter is used for blocking a portion of the light beam when the recording level is low. The black rectangle in the figure represents the shutter vane. The current that actuates this vane is obtained by rectifying and filtering a portion of the signal.

Symmetrical Sound Track

Figure 3-D shows the recording of the sound track used in the High Fidelity System. Here the cross section of the light beam is seen to be a triangle whose sides are equal and whose base is symmetrical with the light slit. The arrows indicate that in this system the beam moves vertically. As in Figure 3-A, the position of the beam with reference to the slit is for zero modulation. Here, with the film alone moving, a narrow strip of white down the middle of a black background would appear on the print.

As the signal is impressed on the galvanometer, the beam moves upward, Figure 3-C, the segment of the triangle cut by the slit becomes longer and light is distributed equally toward both ends of the latter. As the volume of the sound decreases, the segment shortens, the light diminishing toward the middle of the slit.

This alternate expanding and shrinking of the light beam on the moving film gives a printed sound track which is composed of a duplicate row of peaks whose common base line is the center of the track. The unwanted margin referred to in the discussion on ground noise is thus almost totally eliminated.

The current from the biasing coil of the galvanometer controls the movement of the light beam so that the exposed area of the recording negative is limited to the minimum possible without imparing the quality of the sound. This current is obtained by feeding a small portion of the studio input to the galvanometer into the ground noise reduction amplifier where it amplified and fed to the biasing coil.

Compensator Panel

With the improved galvanometer and increased resolving power of the film, the recording of frequencies between 50 and 5,000 cycles presents no difficulty. Above 5,000 cycles, however, there is a certain amount of attenuation.

There is a drop of 5,000 cycles which continues until 9,000 cycles is reached, when the line again rises. The rise is due to resonance of the galvanometer armature which, occurring at 9,000 cycles, acts as a boost from that point on. To overcome the losses occurring between 5,000 and 9,000 cycles is the function of the compensator panel, through which the voice current passes before it reaches the galvanometer.

The compensator consists essentially of a band pass filter and a vacuum tube amplifier. The band pass filter attenuates *all* frequencies to a point where the amplitude of the entire frequency range is approximately the same. Since this amplitude is too low to operate the galvanometer, it is now amplified to the necessary power by the vacuum tube amplifier.

Special Projection Equipment Not Necessary

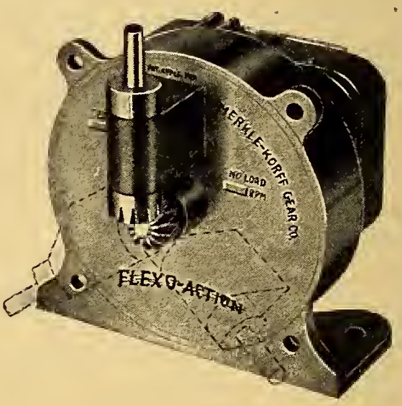
The new symmetrical track may be reproduced by standard projectors without change of equipment and with marked improvement in both the quality and volume of the reproduced sound. However, since existing projection equipment does not provide for reproduction over 8,000 cycles, new equipment has been designed to reproduce the entire range of 40 to 10,000 cycles now possible with the new sound track.

Speed Reduction Unit

A small speed reduction unit with an enclosed motor drive has been placed on the market by the Merkle-Korff Gear Company, 213 N. Morgan Street, Chicago, Ill.

This unit, which is shown in the accompanying illustration, has a wide range of application due to its compactness and that it can be easily adapted to any device or mechanism. The overall dimensions are height 3⅛ inches, width 3⅛ inches and depth 2⅜ inches.

This unit can be supplied for almost any speed required, from motor speed of three thousand revolutions per minute downward. It can be obtained for either clockwise or counter clockwise rotation.



Both horizontal and right angle drives can be furnished. Right angle drives are available with the output shaft in any position around the 350 degree circle.

Reduction units can be supplied with the following type motors as an integral assembly, induction (shade pole type), synchronous, undirectional, reversible and D.C. The gear housing is neatly designed, gears run in grease which is sealed in insuring positive lubrication and quiet operation.

Unit can be used very effectively, due to its compactness and governed speed in automatic color changes. A reduction unit with synchronous motor drive is being utilized in television to motivate scanning discs.

Filter for Projection Equipment

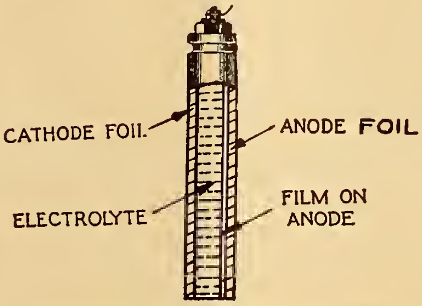
(*Continued from Page* 17)

ed to give satisfactory results. It has been found that if the power factor is 20 per cent or lower, the filtering efficiency of an electrolytic condenser is essentially equal to that of a paper condenser.

Percentage Increase in A.C. Ripple, Across First Filter Condenser, as a Function of Power Factor
E ac for plate equals 350
I load equals 125 mA

Power Factor in Per Cent	*Calculated Percentage Increase in Ripple*	*Measured Percentage Increase in Ripple*
0	0	0
5	0.1	0.1
10	0.5	0.8
15	1.1	1.2
20	2.0	1.9
30	4.5	3.9

In view of these facts research was aimed to design a condenser that would contain no unabsorbed electrolyte, that would have a long life and be free from corrosion. To sacrifice any of these valuable properties to obtain a low power factor could hardly be considered sound engineering.



Cross-section of electrolytic condenser.

It was found that the filter condensers with power factors up to about 20 per cent produce extremely small changes in both the d.c. voltage and the ripple voltage.

If we consider the a.c. ripple voltage across the first condenser to be a measure of the filtering action and also consider that a zero power factor condenser gives maximum or 100 per cent filtering action, then we can calculate the percentage decrease in filtering action which results from the use of condenser of any given power factor. A zero power factor condenser gives 100 per cent filtering action. As the power factor is increased the filtering efficiency drops very slowly at first and then much more rapidly. It will be noted that the curve begins to bend quite sharply for power factors beyond about 20 per cent. The decrease in filtering efficiency for power factors up to 20 per cent is slight and is in fact so small that for all practical purposes it can be neglected. These calculated results have been checked experimentally. The table shows calculated and measured data and they both check quite clearly. The table brings out once again that power factors up to 20 per cent have a negligible effect on filtering efficiency.

**Conradty's*

"The Standard of Excellence for more than 75 years"

PROJECTION CARBONS

"NORIS - HS"
"NORIS-SCH"
"NORIS CHROMO
"HI HI-INTENSITY"

THE technical skill applied to the refinement and manufacture of Conradty Carbons produces its unflinching brilliancy of illumination. They burn more economically and cost no more.

Inquiries Invited.

**A Product of*
C. CONRADTY
Nuernberg, Germany
Established 1855

NORIS CARBON COMPANY Inc.
160 FIFTH AVENUE NEW YORK, N. Y.
Sole Distributor for C. Conradty, Nuernberg, Germany

Carbons for Projection—Arc Lamps—Welding—Microphones—Resistances—Lightning Arresters—Contacts—Carbon Brushes—Electrodes

Projection Equipment in the New Roxy

By C. F. HORSTMAN*

The outstanding theatres of the moment are the two which are scheduled to open in December at Rockefeller Center, New York City. No theatre has ever before aroused so much public interest and expectation as has each of these.

The Motion Picture Projectionist has already published an article on the sound equipment of the International Music Hall. This article covers the installation at the RKO Roxy with particular regard to its picture projection and spotlighting equipment.

In succeeding issues our readers will be kept informed of new developments in projection at Rockefeller Center.

IN the large projection room, located one flight above the third mezzanine of the new Roxy Theatre, are installed four special Type PS-20 Simplex Projection Machines, recent elaborations of projection and light equipment by the International Projector Corporation and Hall & Connolly, respectively.

The projection room is designed from an acoustical standpoint to reduce noise and interference to a minimum. This enables the projectionist to work under conditions that insure maximum efficiency. A booth monitoring system delivers sound to the booth identical in quality and volume level with the sound reproduced in the auditorium itself. This sound reproduction from the auditorium makes it possible for the projectionist to detect and correct any errors in volume level and quality of reproduced sound at all times.

Every unit of equipment in the projection room represents perfection in thermostatic and mechanical control and was designed to spread a restful diffusion of light on the screen and stage. The four projectors insure an unfailing adherence to the schedule of presentation. Should one of them get out of operation, the others can proceed with the presentation of the picture.

Projection Equipment

The projection equipment of the RKO Roxy Theatre marks another landmark in motion picture history. It is an achievement in the development of equipment which gives a closer approximation to daylight than ever before seen on the screen. The installation is the result of a year's experimentation involving a special study of optical systems and the designing and building of improved apparatus.

All of this equipment was specially planned under Roxy's direction to incorporate his ideas of motion picture presentation. In charge of this feature of Radio City is Arthur Smith, who has been associated with Roxy for eighteen years and contributed to many of the important advances in projection during that time. Every conceivable refinement and detail conductive to correct picture projection and screening was effected in relation to the dimensions of an auditorium that has a length of 128 feet from rear wall to curtain line, a width of 158 feet, and seats 3,700.

Sound Projection System

The sound projection system relates to the four projecting machines equipped with a new and improved type sound reproducing head for the presentation of screen attractions. They are located in the main projection room above the third mezzanine in the rear of the house. This soundhead includes the latest developments in sound reproduction equipment and is of a type not heretofore used in any theatre.

Sound from any projector can be fed to the main reproducing system amplifier and the reproduced sound distributed throughout the auditorium by means of three 10-foot and three 5-foot directional baffles. These speakers are the first of their kind to be installed, and this entire reproducing system as a unit will respond faithfully to all frequencies of from 40 to 10,000 cycles per second.

There are six remote volume control stations distributed throughout the theatre where the sound level may be adjusted merely by the insertion of a key in the proper "raise" or "lower" slot of the switch. This arrangement allows the best conditions possible for any special effects that can be gained by volume control.

For the hard of hearing, the theatre has an acousticon equipment. Certain seats in the house are semi-reserved for this purpose. Those making application may have the use of earphones and thus have the advantage of the ideal hearing conditions of the theatre.

Control Facilities

Each projector head, equipped with the latest refinements, rests on Chicago Cinema Bases with Super-Simplex mechanisms of special design to make operation and control of the projectors as simple as possible. Motor switches, changeovers, sound volume controls, censoring switches, etc., are located for greatest ease of operation and control. Lense turrets, holding pre-focussed lenses, makes it possible for the projectionist to change the size of the projected picture at a moment's notice.

Lenses corrected to the last degree for all terms of distortion insure a projected picture having sharp definition and brilliance in addition to being restful to the eye. In combination with these, larger projection lamps with more efficient light-gathering lenses are used and this combination produces on the screen the nearest approach to daylight conditions yet achieved in any theatre. All operation of the projection lamp is controlled by thermostats operating in conjunction with a lens system giving precision accuracy at all times to produce even and good illumination to the screen.

Spotlight Equipment

Two stereoptican and effect machines of the latest developed type enable the projection of an endless variety of novelties, scenic and color effects for stage presentations. With this equipment, such effects as lightning, snow, dawn and twilight, among innumerable others, are simulated. The use of high intensity light sources connection with the light and stage effects, assures that it will be of the highest quality.

Four high intensity spotlamps in the projection room, each of 150 amperes, work in co-ordination with eight similar additional spots located in two special spot booths, one on either side of the main projection booth. These spots are of special design to be best adapted for the conditions under which they work and for the work they are to do. All spots are equipped with complete sets of color frames for color work and are adaptable also for flood lighting. Full operation of these spots is automatic to give maximum in efficiency and performance.

In addition, a complete radio and phonograph equipment in the projection room makes it possible to transmit radio or phonograph programs to the audience at any time over the Public Address System.

Fire Precautions, Ventilation, Etc.

Separate film rooms are provided for the working and storage of film. Four film storage vaults, each accommodating 12,000 feet of film, connect directly to the outside air for ventilation, keep the film in the best of conditions at all times and insure safety to the theatre patrons. An automatic shutter system operating on a trip line enables the booth to be entirely and completely cut off from the auditorium in the fraction of a second. A booth sprinkler system also gives added safety to the projectionists as well as the patrons. All battery rooms are provided with efficient ventilation to take off all battery fumes and ample storage rooms and closets are provided for the storage of spare parts, etc.

---

*Assistant Supervisor of Sound and Projection, R.K.O.

All air entering the projection room is conditioned and purified in similar manner to the theatre air proper. A separate and distinct ventilation system takes off all fumes and carbon smoke from the booth equipment. Hence ideal atmospheric conditions and even temperature exist at all times.

Such is the complexity of the machinery required for the projectors, the spotlights and the color effects for the stage that approximately eighteen men are required to maintain the diversified equipment.

A locker room and a shower room complete the requirements of a well-appointed projection room and provide the necessary comforts for the crew of men connected with the operation and maintenance of the booth equipment.

Acoustics

The acoustics of the Roxy Theatre are the most perfect of any theatre in the world. They were achieved by an extensive study and experimentation on the part of engineers to conquer and solve the problems which have heretofore been prevalent in acoustical conditions.

The installations represent a modern application of sound reproducing equipment to theatre operation. They are particularly designed to allow for expansion and any future developments which may be introduced into theatre use. They are, without a doubt, the largest sound reproducing equipments ever manufactured for theatre installation and are thus in keeping with the Radio City amusement project, the most comprehensive in the world.

Radio, the phonograph, the sound of the human voice synchronizing with the images on the screen, the polyphonic voices of the various instruments of the symphonic orchestra, were carefully studied for the multitude of effects.

The elimination of the remotest possibility of acoustical disturbances resulting from sound waves reflecting and echoing from solid and unbroken wall and ceiling surfaces required intensive study and experimentation of these surfaces, and experimentation also with suitable materials for their decoration. Since equal hearing conditions in an auditorium are largely dependent on equal acoustic conditions, much time was given to the proper distribution of acoustic materials and other treatment that would result in these equal acoustic conditions throughout the auditorium. The selection of materials depended to a large extent on their ability to absorb equally at all musical pitches.

Every square inch of the boundary walls of the auditorium has been considered from an acoustical standpoint and many surfaces are treated with special treatments to give desirable results. The upholstery on the floor is lined to give desirable thickness to this treatment, and the theatre seats of special design, heavily upholstered in velour, silent and self releasing, play an important part in the achievement of maximum acoustic perfection in this auditorium.

The entire ceiling is of acoustic plaster, giving a uniform absorption to this area of more than 10,000 square feet. All rear walls and balcony facias are covered with Rockwool to a thickness of two and three inches. This Rockwool in turn is covered with a special perforated metal and porous cloth to gain the desirable absorption characteristics from these areas. All rear wall areas are so constructed to absorb all sound waves striking them, with a minimum of reflection. The sidewall contour is so designed that there will be no noticeable acoustic interference from sound emanating from any of the sound sources used in the operation of the theatre. Their contour is, on the other hand, so designed that they will tend to reinforce the sound in the most remote parts of the auditorium. This condition makes it necessary to use electrical means of sound reinforcement only on rare occasions and so is very desirable.

The auditorium, in addition to having the above mentioned acoustical qualities possesses an additional feature. This quality is the maintenance of the most desirable hearing conditions regardless of the number of people in the theatre. In other words, the reverberation period of the theatre is not dependent to any appreciable extent on the audience. This is a very desirable feature and is unfortunately not prevalent in present theatres.

The sound equipment in the Roxy Theatre is divided into five systems: Public Address System, Rehearsal System, Stage Manager's Call System, Sound Projection System and Headphone System.

Public Address System

The public address system is designed to pick up the sound from the stage and various parts of the theatre by the latest type of microphone, specially developed and selected for the theatre as the most technically perfect. The sensitivity of the velocity microphone is approximately two and one-half times that of a condenser microphone generally used. This makes possible an increased operating range.

The sound signals are picked up by microphones uniformly located throughout the stage area. The signal is sent throughout the proper amplifiers and distributed over the auditorium through the latest type of speaker. The purpose is sound reinforcing, and heretofore has never been installed in theatres of this size.

Approximately thirty microphones are located at advantageous points in the theatre orchestra, the platform, the stage footlights, the stage elevators, the gridirons above the stage, and the alcoves off stage. The output from every microphone is sent through a control console located in the rear of the house, above the third mezzanine, and adjoining the projection room.

The control room is so located as to make it possible for the operator to hear all sound in the auditorium instantly. The various microphones located on the stage at strategic points are wired to their respective microphone amplifiers which are located either in the basement amplifying room or on the gridiron.

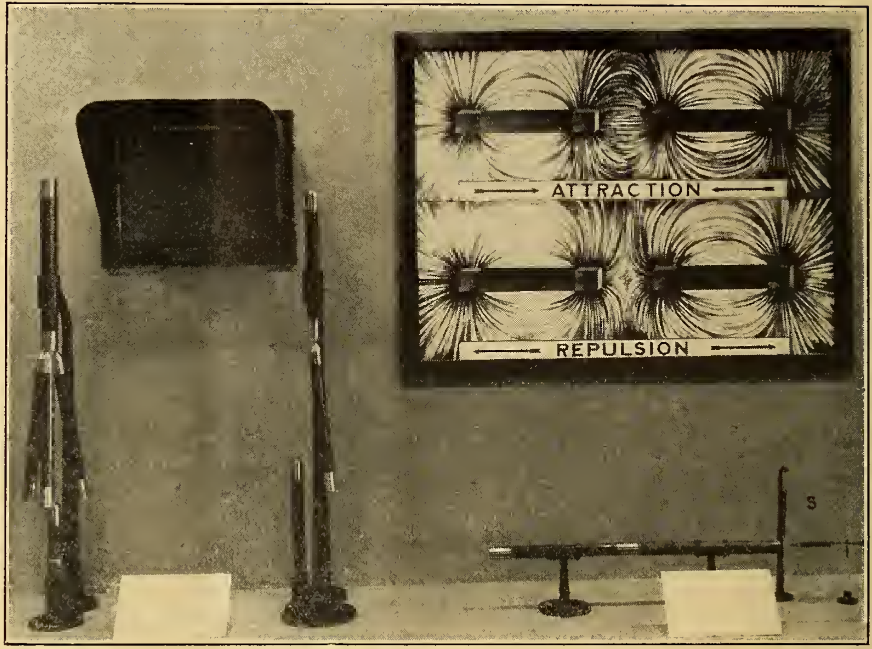
From these two locations, each microphone signal is wired to its respective jack on the Control Console. By means of flexible leads having plug connections, any selection of microphones can be had, and full volume control of each individual microphone is obtained. There are 28 such microphone outlets available. Various groups of microphones work into a sub-master by means of which is mixed the combined outputs of any groups of microphones; then by means of a master control, there is full control over these combined outputs of all groups of microphones in use. In this way the various sounds emanating from the different microphones are combined and full control is had over them at all times by the operator at the control console.

From the control console the signal is fed to the main amplifier system, the output of which is brought back to the control room to a rack having individual controls for each reproducing loudspeaker so that the sound levels at all audience locations can be equalized. The console operator by the pressure of a button can have a monitoring speaker to assist him in detecting and locating any extraneous noises that should develop in the circuit. All amplifiers are remotely controlled to give the operator instantaneous control of his equipment at his finger-tips. Every piece of apparatus on the control panel can be strapped out rapidly on the principle that "the play must go on." Every precaution has been taken so that if a single unit in the console control proves defective, it can be instantly replaced through a second channel.

The Federal Circuit Court of Appeals of Argentine has dismissed the sixteen patent infringement actions brought by the Corporation Argentine Americana de Films, local holders of the De Forest patents, against Western Electric equipped theatres, according to definite advices received by Electrical Research Products. The cases, which were defended by the Western Electric Company of Argentine, have been before the Argentine Courts for two and half years.

A Museum for the Sciences

By KASKEL KALLMAN*



Some of the exhibits demonstrating principles of magnetism. One of the automatic 16mm. units used for motion picture illustration is seen at the right.

TO MOST people, a museum is a place in which the efforts of educators and the money of philanthropists have made possible the collection of objects representing every period in history, in order that new generations may add to their knowledge of the customs and crafts of those that went before them. To spend a thoughtful afternoon going through the rooms of a museum is usually to journey in imagination down the long corridors of the centuries, and it is seldom that we associate with such a visit the idea of anything which mirrors our own time.

Among the many museums in New York City, however, is one which has been dedicated to science rather than to history. Many of its exhibits show the growth of great industries so interestingly that one's attention is held however slight may be his taste for antiques; but visitors to this museum are impressed chiefly by the scientific wonders of the present day and their imaginations are led more towards the future than into the past.

The New York Museum of Science and Industry, the name of which is fully descriptive, was opened in 1927 with an endowment by the late Henry R. Towne of the manufacturing firm of Yale & Towne. Its location is in one of Manhattan's most strikingly modern skyscrapers. The Museum does not pretend to be complete at the present time. There are other and older museums in Europe, where exhibits, representing every branch of science and industry have been carried out on a much larger scale. Chief among them, is the Deutches Museum at Munich, Germany, which is the largest and most complete industrial museum in the world. There, the exhibits total nine miles, some of them showing even full-scale modern locomotives in cross-section and with their moving parts in operation.

However, it can be said without exaggeration, that the New York Museum of Science and Industry is, as yet the only one of its kind on this side of the Atlantic, and that the man whose work or hobby lies in the fields it represents will find much here to interest him.

The museum is at present composed of the following sections: Transportation, Tools, Power, Food Industries, Textiles, Shelter, Aviation, Communication, Mechanics and Electrotechnology. Some of the exhibits in these sections are changed from time to time and, as funds become available, new sections are being added.

The Museum's Models

The interest that models hold even for people who are not of a mechanical turn of mind is often demonstrated by the number who will gather before a show window to look at a small-scale replica of any familiar thing. Among the Museum's exhibits are many excellent models. Perhaps the most interesting is the full-scale reproduction of the first locomotive, which has been exactly copied from the original "Rocket" in the South Kensington Museum in London. In the same room, are several smaller models of the engines which pulls the transcontinental trains of today. The Transportation Section also contains some interesting models of ocean liners, ranging from the early side-wheelers to the modern express liner "Bremen."

The models of boilers and furnaces to be seen in the Power Section are equally worthy of note. New York is only one of many great cities where, if the boilers in its power plants ceased operation, almost the only wheels continuing to turn would be those of automobiles and baby carriages. Projectionists and many other people would come to the realization that though this has been called the age of electricity, the bright whiteness of the projection arc and the subdued glow of the reading lamp are alike dependent on the little-heard-of assembly of drums, pipes and bricks that is the modern steam boiler.

In the Food Industries Section is a model of a refrigeration plant which is perhaps as perfect a model as has been built of anything. The section on Shelter shows in part, the growth of architecture from the adobe hut to the modern skyscraper, while that devoted to textiles affords a visitor some idea of the complex operations involved in the manufacture of the cloth his clothes are made from. Considerable space has been devoted to the Aviation Section where the visitor has an opportunity to study first hand the elementary principles of aerodynamics, and where the operation of the famous radial type of aeroplane engine may easily be understood.

Gadgets and Gyrations

Leaving the section devoted to tools which traces their growth from the early type of lathe to the machine tools on which modern civilization so much depends, we come to the Mechanics Section. The man for whom wheels, gears, cams and levers hold a strange fascination can spend an absorbing hour in this section of the Museum alone. For there are mechanisms shown here which perhaps many a mechanical engineer has not seen except between the covers of a text-book. Every important mechanical combination is shown by models ingeniously arranged on large upright boards. There are bevel gears with half their teeth cut away which mesh with others to give a continually reversing movement, square gears which impart a variable speed to the driven shaft, elliptical gears with teeth cut at angle, and besides a few others we possibly have forgotten—just gears. Among the several different devices

---

**Director, Motion Picture Division, New York Museum of Science and Industry.*

for creating intermittent motion, the projectionist will recognize that mechanical heart of the motion picture machine, the Geneva movement. Then there are out-of-line drives, variable-speed drives, universal joints and strange matings for transforming rotary into reciprocating motion or vice versa,—not to mention another "gadget" with arms like a pair of ice-tongs, which slowly picks up a weight, drops it suddenly and then resumes the lifting operation. The visitor standing before one of these boards, has merely to press a button to put its bewildering array of mechanisms through their automatic acrobatics.

Seeing Your Voice

Coming to the Communication Section, we find exhibits which are of direct interest to the projectionist, since most of them involve the reproduction of sound. Here, for instance, the telephone receiver, often referred to in illustrating the principles of the microphone and loudspeaker, may be viewed conveniently dissected. It is also possible to see what happens in a machine switching exchange when one lifts a receiver from its hook and dials a call.

It is in this section too that we find the Audiometer and a Cathode Ray Oscillograph. The first is a device designed to test an individuals' hearing. In articles on good sound projection, mention is frequently made of the part the projectionist plays in giving a better show by correcting for differences of sound level on the print. These articles seem to assume that all operators hear alike. The Audiometer which gives the visitor the scientific "lowdown" on his hearing proves that this cannot be taken for granted.

The Cathode Ray Oscillograph consists mainly of a gas filled tube from the cathode of which electrons are emitted and strike the walls of the tube producing a luminous glow. The visitor speaks into a microphone and the effects of the voice current deflect the electronic emission so that they form a thin green line on the wall opposite the cathode. The variations in this line are a reproduction of the sound waves produced by the voice. This may not sound as simple as is intended, but we feel sure that the oscillograph is worth the attention of projectionists. The pictures with which sound and radio engineers are so fond of adorning their articles seem less like a message from a departed spirit after on has watched the performance of this instrument.

The Turning of the Molecule

And now we come to the exhibits in the section on Electrotechnology, the outline of which has been the chief purpose of this article. Like many others in the Museum, the distinguishing feature of these exhibits is the manner of their presentation. The visitor presses a button or turns a crank and abstract electrical principles are clearly demonstrated. In some cases, large schematic diagrams and transparencies supplement the demonstration and identify it with its theory as set forth in books. In other exhibits this is accomplished with the aid of 16mm. motion pictures or lantern slides.

All discussions on elementary magnetism and electricity mention the Earth's magnetic field, but they seem to suggest that the only tangible proof of its presence is its effect on a compass needle. One of the Museum's electrical exhibits enables the visitor to generate an electric current by turning a simple armature in the Earths field and read its quantity on a microammeter.

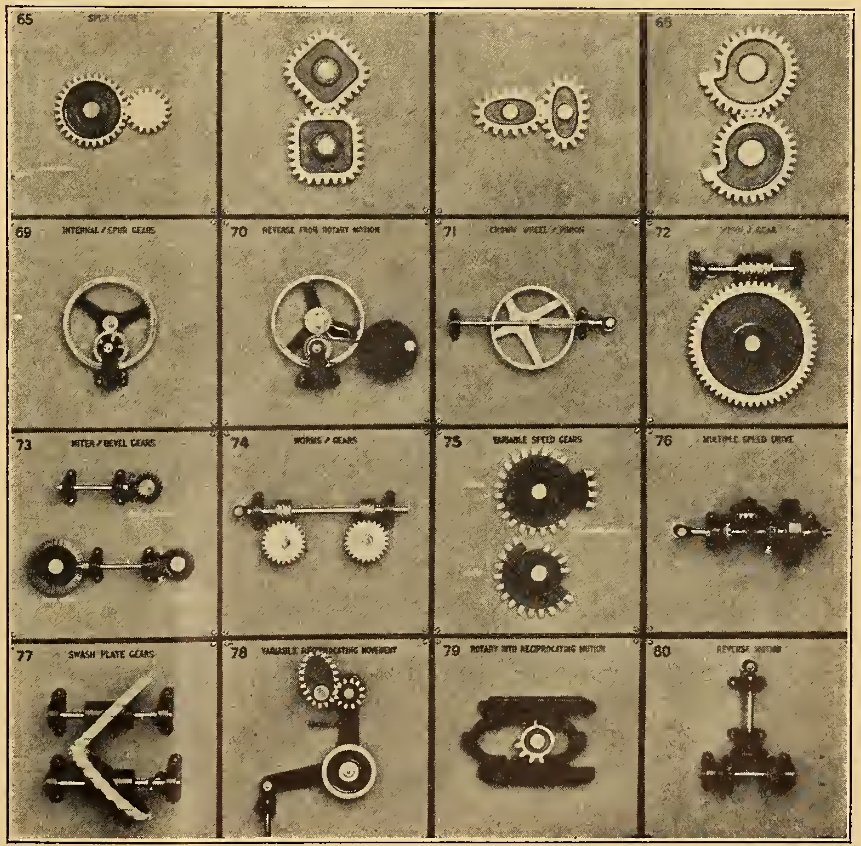
It is impossible to see the lines of force about a magnet, but a number of simple exhibits make them all but visible. Others show the law of attraction and repulsion and other fundamental principles so clearly that even one who has already had considerable experience with electrical apparatus may well benefit by seeing these illustrations. One of the most interesting of them is that which demonstrates the fact that when a non-magnetic piece of iron is placed in a magnetic field, its particles align themselves with the lines of force. A piece of soft iron is inserted in a finely wound coil and a horseshoe magnet rotated near to the coil. The very weak potential generated in the coil by the molecules turning in response to the action of the horse-show magnet is amplified and reproduced in a speaker. Thus, by rotating the magnet very slowly, it is possible *to hear the molecules as they turn.*

Ohm's Law Made Plain

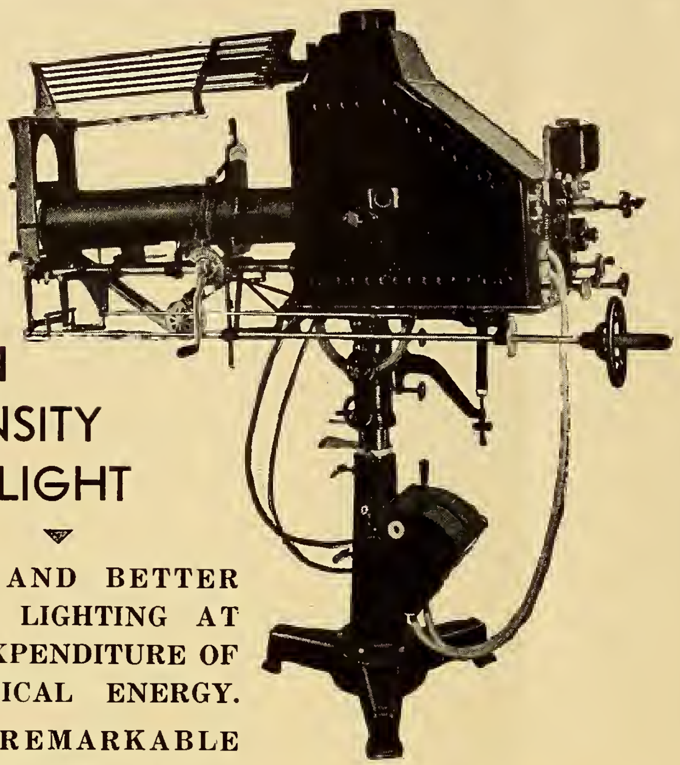
It is common knowledge that to generate voltage three things are necessary—a closed circuit, motion and a magnetic field. Without one of the three, it is impossible to generate voltage by mechanical means. In one of the display cases is repeated the famous experiment performed by Michael Faraday, the brilliant English physicist who discovered the principle of the dynamo early in the 19th century. To a coil of wire is attached a sensitive ammeter. A mechanical hand alternately lowers and raises a permanent bar magnet into the coil. The visitor discovers in much the same way as Faraday that when the magnet moves into the coil, the needle moves one way; when the magnet stops, so does the current; when the magnet goes up, the direction of current is reversed.

Enough for the elementals. It is necessary to investigate the meaning of Ohms' Law as applied to simple circuits. Before passing, however, there are several ehibits on chemical electricity and chemical effects, such as electroplating, electrolysis, etc. There is another group of models showing the magnetic fields generated by electromagnets, and, yet another group explains just why a D.C. motor functions.

(*Continued on Page* 33)



One of a number of large boards on which are mounted different mechanical combinations. The visitor standing before one of these boards presses a button to set its mechanisms in motion.

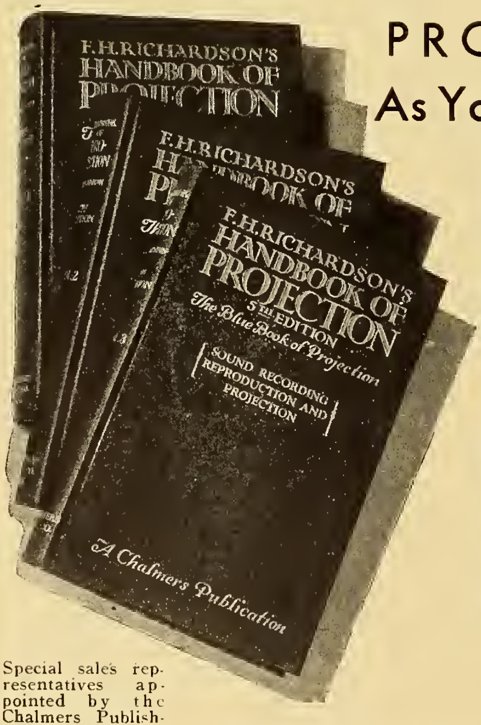


HIGH INTENSITY SPOTLIGHT

MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, INC.
24 Van Dam Street New York, N. Y.
H&C INC.



F. H. RICHARDSON'S HANDBOOK OF PROJECTION
F. H. RICHARDSON'S HANDBOOK OF PROJECTION
F. H. RICHARDSON'S HANDBOOK OF PROJECTION
5TH EDITION
The Blue Book of Projection
SOUND RECORDING REPRODUCTION AND PROJECTION
A Chalmers Publication

PROJECTION
As You Must Know It

This 5th edition HANDBOOK OF PROJECTION by F. H. Richardson is known the country over. It has been the means of making thousands of projectionists masters of their profession. Remember, Richardson gave the "operators" of 1910 the first projection manual ever written.

Now 3 Volumes

Over 1,400 pages of the most vital kind of information. More than 400 illustrations. Each volume carries the special Richardson question and answer index—the greatest feature any projectionist could wish to have.

If your future is linked with projection make it brighter and securer by owning and studying this finest of projection libraries.

The complete set of three volumes mailed to your door upon receipt of check or money order for $10.25.

Special sales representatives appointed by the Chalmers Publishing Company, publishers of the Handbook on Projection. - - - -

MANCALL PUBLISHING CORP.
7 West 44th Street New York City

W. E. Develops New Pre-View Attachment

ELECTRICAL Research Products has developed and made available for use, a new pre-view attachment that is being utilized by West Coast producers at a considerable saving in pre-viewing talking pictures in theatres in California. The attachment's advantage is that it enables the sound track and the picture to be run on separate films through the same machine, obviating the expense and time involved in processing a composite print which would be otherwise worthless for subsequent cutting and editing.

While the process is subject to modification according to the type of projector in the theatre, the usual procedure is to remove the front plate of the projector head and mount in its place the attachment which is driven from the main drive sprocket by a series of gears and silent chains. The attachments, which are adaptable for the use of "split" film (sound track on 17½mm.), necessitate the replacement of the regular optical assemblies and of the gates with a new type carrying an extra guide for the narrow film. The standard film guide roller is also replaced by one which is adjustable either for standard or split film.

During the past few weeks the Western Division Operating Department of Electrical Research Products has effected the installation of these attachments in theatres chosen by the studios for pre-view on notice sometimes as brief as a last minute telephone request.

A typical example occurred recently in the case of a picture with an internationally famous star. This was shortly to be released. The producing company requested the installation of pre-view equipment in the Fox Theatre, San Diego, on the day before the morning rehearsal was to be held. The attachments were rushed to San Diego by car and installed after the last show that evening. A rehearsal for 100 studio members was held at 5 A. M. the following morning and the public pre-view was held the same evening. The equipment was removed and returned to Los Angeles by car after the pre-view.

Immediately after the pre-view the equipment was removed and rushed to the Fox Theatre, Pomona, where preparations were made for the advance showing of another picture. This pre-view attained significance from the fact that it marked the first use, in any studio theatre preview of 17½ mm. film. Wide Range recording was also used for the dialogue of this picture.

Highest praise from studio executives has been the result, not only for the successful staging of the pre-view but especially for the demonstrated economy and efficiency of the new pre-view attachment.

Answers to Questions on Patents

By RAY B. WHITMAN

A Department established for the solution of patent difficulties.

Readers are urged to avail themselves of this free service for advice on the subjects of Patents, Trade Marks, Designs and Copyrights. If a personal answer is desired, a stamp should be enclosed with the inquiry; otherwise the question and its answer will appear in this department in the first available issue. Address all questions to the Patent Editor in care of THE MOTION PICTURE PROJECTIONIST. *Write on one side of the paper only, giving full name and address. (Only initials will be published if requested.)*

Q. Can a person who sells a patent ever attach its validity thereafter?—G. R., Auburn, N. Y.

A. No. never. By Section 4898, every patent or any interest therein is assignable in law by an instrument in writing, and the patentee or his assigns or legal representatives may, in like manner, grant and convey an exclusive right under his patent to the whole or any specified part of the United States. Also, an assignment, grant or conveyance shall be void as against any subsequent purchaser, or mortgagee, for a valuable consideration, without notice, unless it is recorded in the Patent Office within three months from the date thereof. Also, while a seal is not required to make an assignment legal, there seems to be no reason why the principles of estoppel by deed should not apply to assignment of a patent right in accordance with the Statute. Its purpose is to furnish written and recorded evidence of title, and to protect the purchaser of the title as recorded for value without notice.

It was manifestly intended by Congress to surround the conveyance of patent property with safeguards resembling those usually attaching to that of land. The Supreme Court, in fact, has recognized the analogy between estates in land by estoppel, and the right to enjoy a patent right in the use of an article conveyed by one without authority, but who acquires it by subsequent conveyance.

One of the rules of assignments to be carefully borne in mind by everyone who sells an interest in a patent is that one which provides that an assignor of a patent right is estopped to attack the utility, novelty, or validity of a patented invention which he has assigned or granted as against any one claiming the right under his assignment or grant. As to the rest of the world, the patent may have no efficacy and create no right of monopoly; but the assigner can not be heard to question the right of his assignee to exclude him from its use.

The analogy between estoppel in conveyances of land and estoppel in assignments of a patent right is clear. If one lawfully conveys to another a patented right to exclude the public from the making, using and vending of an invention, fair dealing should prevent him from derogating from the title he has assigned, just as it estops a grantor of a deed of land from impeaching the effect of his solemn act as against his grantee. The grantor purports to convey the right to exclude others, in the one instance, from a defined tract of land, and in the other, from a described and limited field of the useful arts.

It has been held that the state of the art may be considered in defining the limits or boundaries of the patent grant, and so while the assignor may not use the state of the art to destroy the patent and defeat the grant, since he is estopped from doing this, yet he may use the state of the art to construe and narrow the claims of the patent, conceding their validity. Of course, such evidence might not be permissible in a case in which the assignor made specific representations as to the scope of the claims and their construction, inconsistent with the state of the art, on the faith of which the assignee purchased; but that would be a special instance of estoppel by conduct.

Thus, it behooves every one who purchases a patent to attempt to obtain from the seller some representation as to what the patent is supposed to cover, and to purchase on that basis; and conversely, it behooves the seller to carefully refrain from making any statements which might later be considered as a representation or guarantee of the scope of the patent, for he may be depriving himself of the right in a later emergency to allege non-infringement because of the limited scope of the claims.

The above statements refer only to cases where the assignment of the patent rights during the application stage, and before the issue into a patent, it is apparent that the scope of the right conveyed by such assignment is much less defined than that of a granted patent; and the question of the extent of the estoppel against the assignor of such an inchoate right is more difficult to determine than in the case of a patent assigned after its granting. When the assignment is made before patent, the claims are subject to change by curtailment or enlargement by the Patent Office with the acquiescence, or at the insistence of the assignee, and the extent of the claims to be allowed may ultimately include more than the assignor intended to claim. This difference might justify the view that the range of relevant and competent evidence in fixing the limits of the subsequent estoppel should be more liberal than in the case of an assignment of a granted patent.

Editor's Note: The future of sound pictures is secure but whether it will remain the monopoly of the electrics or be thrown open to all manufacturers remains for the courts to decide on the basis of patent ownership. Mr. Whitman's discussion of patents is therefore most pertinent.

The Latest in Hairsplitting

A vacuum tube, declared the most sensitive measuring device in the world, which will measure an electric current as small as 1-1,000,000,000,000,000,000 ampere, has been developed by engineers of the General Electric Company.

This tube, of the four-element variety, will also measure the flow of six electrons per second, count cosmic rays and in cooperation with a photoelectric tube, or "electric eye," will measure the light from distant stars.

If the six electrons per second that are measured by the tube are considered as that many drops of water, then the number of electrons flowing in one minute through the usual fifty-watt incandescent lamp equals the number of drops in the enormous volume of water going over Niagara Falls in a whole century.

Patents

A Complete service:

Inventions developed. Models and drawings. Also searches.

Patents obtained by registered Patent Attorney, former patent chief of large corporation, and a successful inventor himself. Rates low for highly skilled service.

Foreign patents obtained economically through associates abroad, visited during world tour.

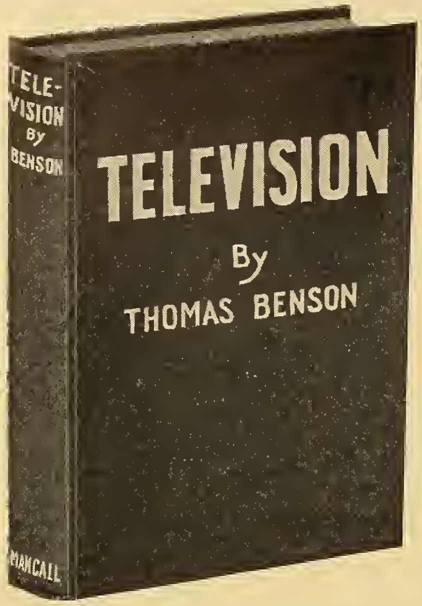
Sales campaigns conducted, on commission, to market patents. Contracts drawn.

Also trade marks, designs, and copyrights.

Write for FREE ADVICE, or phone.

RAY BELMONT WHITMAN
227 PARK AVE., N. Y.
Phone: WIckersham 2 - 7600

BE PREPARED!



TELEVISION
FOR THE
PROJECTIONIST

A COMPACT little book, complete with illustrations and diagrams, embracing the basic fundamentals of television instruments used in television today.

NOW
$1.00
FINAL EDITION
Only Few Copies Left
ORDER IT TODAY

Some of the Contents

—Elements of Visual Communication
—Light Sensitive Cells
—Scanning Methods
—The Television Signal and its Amplification
—Transmission Channels for Television
—Light Sources for Television Reception
—Reproducing the Image
—Synchronizing Methods
—Stereoscopic and Color Television
—Experimental Television

SEND THIS COUPON TODAY

Mancall Publishing Corp.,
7 West 44th St., New York City

Enclosed find money order for $1. Please send me Benson's Television.

Name..

Address..

City and State..

Theatre..

Sound Absorption Materials

(*Continued from Page* 9)

absorption of the walls, ceiling and floors, from the total amount and what remains is the amount that must be added to the room to get the reverberation time of one second. In dealing with openings in the room such as open doors into rooms we treat them as a positive or negative absorption. If the room on the other side of the opening is highly absorbent we estimate a coefficient for it and multiply this by the area of the door. The absorption which we obtain is then subtracted from the total necessary to correct the room. If the room is highly alive we will have to estimate a low coefficient for the opening.

Selection of Material

After we have determined the amount of absorption that we need to correct our room we must select the material. In selecting the material we ought to bear in mind that if we have a large amount of reflecting surface we ought to get a material with a low coefficient so that we have enough of it to cover all of the objectional reflecting surfaces. If we do not have objectional reflecting surfaces we may select a material with high coefficient and concentrate it in one place. Suppose for example, that in our room we have some reflecting surfaces which give us the trouble, I mentioned in the beginning of having the reflected path greater than the direct path. To overcome this difficulty we will have to place some of our absorbing material on this surface so that the reflected ray will be of considerably less intensity than the direct ray and as a result the objectional reflection will not be so noticeable. If the surface is too large for our absorbing material we will have to resort to coffering so as to break up the reflected ray into different length paths.

Curved Surfaces

In treating curved surfaces for echo, coffering is about the only absolute cure, but there is another idea of changing the phase relation of parts of the reflected ray so that most of it is eliminated by phase opposition. This is accomplished by placing material of high reactance in strips mounted away from the curved wall. Incident sound then suffers a change of phase and a direct reflection from the wall between the material. This method is not as satisfactory as it might be because of the necessity of covering the whole set-up with a cloth and then decorating the cloth.

This same analysis of an acoustically incorrect room is applied to a theater in which the acoustics are very bad. If the house is to be used for rehearsals and reverberation time should be so adjusted so that it will be approximately the same as when the house is filled with auditors. This can be done in several ways, i.e., by having high absorbing material which can be covered as the house fills up. Again the stage should not be made highly absorbent since it is highly desirable that the speaker should have all the reinforcement he can get.

An Important Little Lamp

(*Continued from Page* 18)

of the 8.5-volt lamp is reduced 0.1 amperes, the gain control must be advanced 1.5 DB to regain the same level of sound.

Some projectionists have been inclined to reduce the current in the lamp with the thought of decreasing exciter lamp renewal cost. The saving thus obtained is insignificant when compared with other projection room expenses, and the effect on the quality of the reproduced sound is very decided, especially with the new high-quality noiseless recording.

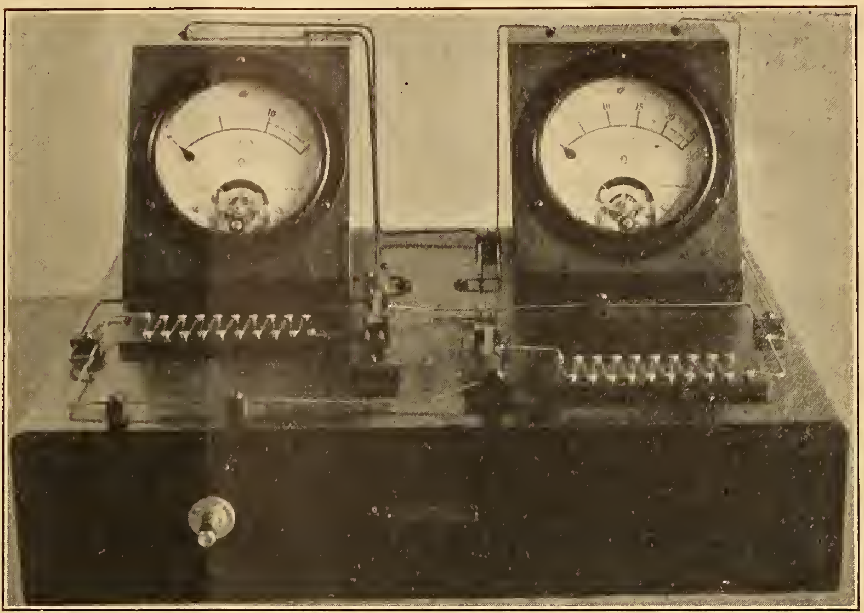
The care of the storage battery for exciter lamp supply is a chore that most projectionists would like to avoid. Many schemes of eliminating the battery have been suggested. Because the light output of the standard photocell lamps will follow to a slight degree the cyclic variation of 25 to 60 cycles alternating current and thus introduce a hum into the loud speaker output, operation of these lamps from a small transformer is not practical where full sound frequency range is desired. Those systems that do operate the lamps from alternating current must use high pass filters to remove the hum, and unfortunately these remove some of the voice and musical frequencies.

Hum free operation can be obtained if the lamp is supplied from a rectifier-filter device, of which there are several on the market. Of course, such a device must have sufficient additional capacity to take care of the loud speaker field. For most satisfactory operation of the lamp, an ammeter should be included in the circuit either in the projector or the power supply device.

Experimental work on photocell lamps of the indirect heater type similar to A.C. vacuum tubes has so far been unsuccessful because it has not been possible to bring the light-giving area to a sufficent brightness.

(*Continued from Page 29*)

The instructor in a branch of the mechanical arts has comparatively little difficulty in the illustration of his points. Gears, valves, cylinders may be seen and handled or conveniently compared to numerous familiar objects, while some of the most important principles of mechanics are illustrated by a variety of everyday occurences or experiences. The study of electrical principles, on the other hand, leads one into the realm of the invisible and intangible, where the most talented lecturer or author must leave much to the imagination of the student. In their demonstration of principles which underly the operation of all sound projection equipment, some of the exhibits outlined in this article are unique. We believe that projectionists within New York's metropolitan area will find a visit to the Museum of Science and Industry a valuable means of suplementing the knowledge they have gained from textbooks. The Museum is open daily. There is no charge for admission.



Resistances in Series and in Multiple. Voltmeter on left shows constant potential across circuit. Two single pole double throw switches connect the resistances, singly, in series, or in multiple. Ammeter at right shows change of current.

Ohm's Law embraces all the essentials of an electric circuit. Is it understood clearly and completely? It must not be forgotten that Ohms' Law operates also for alternating current, taking into consideration capacitive and inductive reactance. The first model illustrating this principle shows the equal drops of potential along a wire of uniform cross-section carrying a constant current for equal distances along the wire. Another circuit contains a lamp (pure D.C. resistance) and an inductance coil in series. A switch allows either direct or alternating current to circulate. Three volt meters are connected, respectively, across the lamp, the coil, and the two in series.

When the direct current is turned on one meter reads eight volts, and the other four, and, of course, the total is recorded on the third volt meter as twelve, but with alternating current both meters read seven volts and the total is not fourteen; it is twelve. Are you sure that you could explain the phenomenon to the other operators in your booth? Here again by means of wall diagrams, this is explained in a very simple manner.

Inductance and Capacity

With the advent of sound equipment in the theatres, the operator has learned there are such things as condensers and inductance coils. He probably knows that the capacity effect can balance out the inductive effect and a condition of resonance is obtained. This resonance makes possible the functioning of all our radio sets. Do you have a clear picture of exactly what is meant by capacity and inductance? Museum models show exhibits of each and the wall diagrams show a mechanical analogy of them.

Induction motors are not forgotten. In another section can be found mystifying displays; a hollow copper ball is floated in a small beaker of water, when the current is turned on the ball rotates continuously. Another exhibit has a ring spinning incessantly on a curved glass dish. The ball exhibit demonstrates perfectly the shading coil motor, and the spinning ring, a simple induction motor. Diagrams show the various induced currents and magnetic fields and explain simply why they operate.

At the present time sections covering photoelectric effects, thermionics, ionization of gases, electromagnetic waves, and the applications of photoelectric cells are in preparation. When these are functioning the exhibits will offer to the visitor a complete synopsis of the entire subject of Electricity.

Motion Picture Auditorium

Though it can hardly be classed as a museum exhibit, one of the most interesting features of the Museum is its moving picture auditorium. It is believed that the Museum is the only organization presenting a daily program of industrial pictures throughout the year. Every day from 12 noon to 2 P.M., industrial and scientific pictures are screened for the general public, the entire program being changed every two weeks. These pictures come from 125 different sources. Here is a typical program scheduled to run from November 19th to December 2nd.

"Martex." One reel, silent. Subject: Making a Turkish towel.

"Milk." One reel, silent. Subject: Making a can of evaporated milk.

"Call of the East." One reel, sound. Subject: A Chinese telephone exchange.

"The Better Way." Five reels, sound. Subject: Manufacture of electric refrigerators.

"The Rolling Car.' Three reels, silent. Subject: Distributing cars in a freight yard.

"The Neck of the Bottle." Four reels, silent. Subject: Centralized traffic control for railroads.

"Oxwelding and Cutting." Two reels, silent. Use and theory of acetylene torches.

"Man Made Miracles." One reel, sound. Subject: Manufacture of radio tubes.

"Service to Industry." Two reels, sound. Subject: Repair shops for electrical equipment.

Increasing Popularity

That the pictures are as interesting as their titles and that they are becoming increasingly popular is shown by the attendance. The auditorium seats 147, but the daily attendance during the two-hour period is slightly over 200. From October, 1930, to October, 1931, the daily attendance totaled 42,000. For the corresponding period ending this year, there has been an increase of fifty per cent. Some of the pictures occurring in these programs are of particular interest to projectionists as is suggested by the title of at least one of those which appear above. Others run recently showed the engineering of sound films in the Bell Laboratories, the manufacture of motion picture film in the Eastman plant at Rochester and talkie equipment in the making.

In addition to the regular daily programs, the museum frequently arranges special screenings for scientific groups and classes of students ranging from elementary schools to colleges within the metropolitan area. This service is being used more and more by schools in the New York Public School System who do not have the facilities for motion pictures.

A Reproducer on Wheels

When the Metro-Goldwyn Trackless Train starts its tour of the world it will carry with it a Western Electric Reproducing System installation, devised and completed by the engineers of Electrical Research Products, that represents one of the most exacting problems sound engineers have ever had to deal with. Non-synchronous turntables, announcing equipment, radio reception and every facility for demonstrating the various equipments for power generation are included in the installation.

The sound system comprises an 8,000 pound load, including more than a ton of batteries. A 120 section of the batteries is provided for operating motors, converters and light. A 12 volt battery is provided for the sound system. The tender contains a large gas-electric generator for charging batteries which are, in turn, located in the iron cribs in the chassis of the trailer car. The generator also supplies the current for the high intensity arc projector.

A carbon microphone placed in the projection room of the trailer and a dynamic speaker mounted in one of the walls of the passageway make it possible to describe the operation of the equipment to visitors as they pass through. The screen room, arranged for rear projection, is behind the projection room, a projecting glass plate constituting the rear wall of the car. The screen is arranged for outside audiences, its bottom well above the heads of a crowd outside. Cove lights throughout the interior give bright illumination. The rear projection feature requires special prints for sound on film recorded subjects.

Space Limitations

The problem confronting sound engineers in the installation arose from the small space in which so large a quantity of apparatus had to be placed. Despite these space limitations, the installation was planned and completed in such a way that every piece of equipment is easily accessible.

A single Western Electric reproducer set is mounted slightly off the center of the room, allowing space for the operator on one side. Over the rear axle are two dwarfed amplifier racks, one above each wheelhouse. Behind the operator is a rewind shelf, end-to-end with the non-synchronous set. Under the rewind is the motor control box for maintaining constant speed. Beneath the non-synchronous set is a storage and reel cabinet. On the opposite side a large power control board containing the charging switches, reverse current breakers, lighting panel, etc., is mounted on the back of a narrow door in the projection port partition giving access to the screen room. The amplifier racks and reproducer set are mounted on special tapered springs which absorb vibration in three directions. The reproducer set is equipped with compression clamps which hold it rigidly in place during operation and permit leveling.

The screen room reveals the rear of the amplifier racks and contains two storage cabinets and two inverted converters. One of them supplies the amplifiers, and the radio receiver. The other supplies the light signs.

Ingenious Design

The ceiling of the screen room is almost entirely occupiedby two hatchways through which the screen horns drop on hinges when they are not in use. En route the screen area at the rear of the car is covered by removable panels. During a show these panels project from both sides of the screening window with a canopy across the top, forming an effective shadow box to minimize the reflection of lights from the street.

In the center of the car's roof are four mounted public address horns with No. 551 type receivers for use for announcement or radio reproduction on occasions where battery current for the screen horns must be conserved or when sound projection must be obtained in all directions.

The hatchways for the screen horns cover over with steel lids when they are not in use. During a show the lids support the horns in position above the screen.

All wiring has been concealed in the construction of the train without impairing the strength of the construction. The screen has been made dust proof, heavy pieces of equipment are mounted on springs, and every piece of equipment left accessible. Precautions were taken against noisy reproduction by the use of flexible, copper shielded wire throughout and by the application of filters to the converters.

Safe traveling for sound equipment is further safeguarded by extra heavy springs, special axles and wheels and air brakes. The equipment includes adequate power for presenting an elaborate show.

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets; Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO.. 844 So. Wabash. Chicago.

Notes

A "radio-controlled man," that walks, brandishes a sword, and flashes artificial lightning from his blade, is the strange robot constructed at the Metro-Goldwyn-Mayer studios in Culver City.

The "metal man" is used to enact the "reincarnation of Ghengis Khan" in "The Mask of Fu Manchu," with Boris Karloff playing its wily inventor and operator.

The affair works through storage batteries within itself, and a series of controls will be actuated by short wave radio. Motors, levers, cams and cogs do the rest.

C. W. Bunn, General Sales Manager of Electrical Research Products, announces a contract to install a Western Electric Sound System on the Furness Steamship, now under construction, *The Queen of Bermuda.* It is a sister ship of *The Monarch of Bermuda* which is Western Electric equipped.

Preliminary wiring is being done at the shipyards in England where the steamer is being built and the installation will be completed after its arrival in this country.

Clarence Wall, one of the best known technicians in the motion picture industry, who for upwards of two years was technical director for Fox Movietone in Europe, has been placed in charge of sound recording operations at the New York studio of the RCA Victor Company, No. 411 Fifth Avenue. With the marked increase in recording activities, brought about by the recently introduced "High Fidelity" system, Mr. Wall has been giving particular attention to re-recording from 35 mm. to 16mm. sound. Complete facilities for the reduction of 35 mm. subjects to 16 mm. and the synchronization of sound with silent pictures, have been installed in the Fifth Avenue studio.

With upwards of 300 battleships, destroyers, cruisers and shore stations equipped with Photophone sound reproducing apparatus, the Navy Department has awarded a contract to the RCA Victor Company for the installation of similar apparatus aboard the U. S. S. Farragut, Dewey, McDonough, Hull, Minneapolis, Tuscaloosa, San Francisco and Worden.

The United States Army, which has Photophone reproducing equipment in 75 army posts in various parts of the world, also has placed an order for an installation at Quarry Heights, Panama Canal Zone.

World theatre installations of Western Electric sound equipment numbered 9,354 on September 30, according to a compilation just completed by Erpi. Of the total installations, 5,473 were in the domestic field and 3,881 in the foreign.

THIS BOOK IS A CHALLENGE TO EVERY PROJECTIONIST IN AMERICA

More Miehling books have been sold to projectionists than any other. . . . There have been others since Miehling's book was brought out . . and all at a higher price . . . but Miehling's still remains as the only book written by a projectionist for projectionists. . . . That is why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of ALL sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

NOW ONLY

$2

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.

●

519 pages . . . .
Completely indexed
Fully illustrated.

Do Not Delay! Fill in this coupon and forward to us at once with your remittance. Do it now!

MOTION PICTURE PROJECTIONIST
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $2.00.

Name..

Address..

City and State..

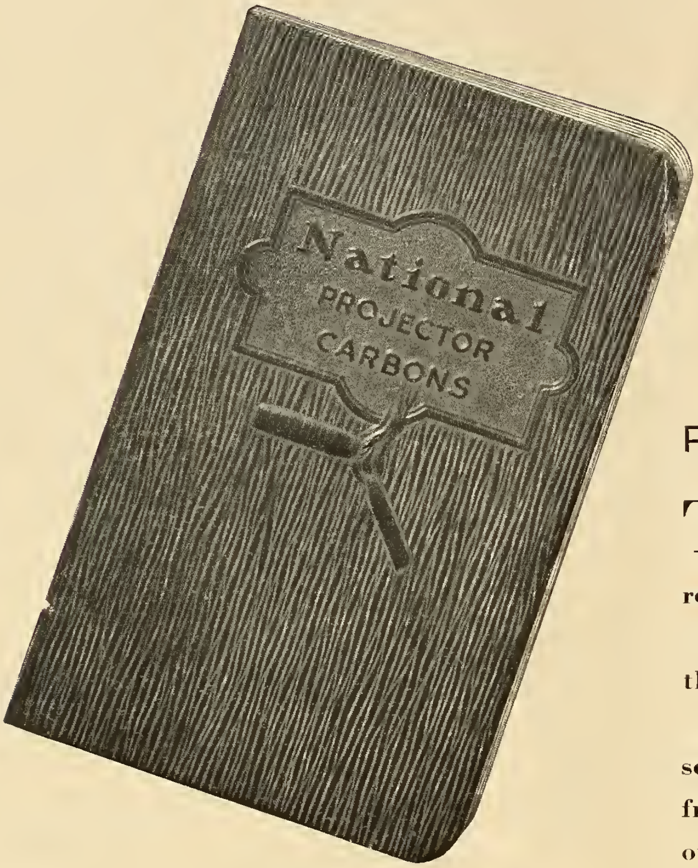
Position..

Theatre..

A NEW HANDBOOK

on

NATIONAL
PROJECTOR CARBONS



96
Pages

58
Illustrations

FREE—TO EVERY PROJECTIONIST

THE new and completely revised edition of the National Projector Carbon Handbook is now ready for distribution.

This book discusses, in detail, the application of the carbon arc to all types of projection lamps.

It contains the practical information needed to secure maximum volume of screen illumination, freedom from trouble and most efficient operation of projection lamp equipment.

SEND FOR YOUR COPY TODAY
Use the coupon at the bottom of this page.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division . Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices:
New York Pittsburgh Chicago San Francisco

NATIONAL
PROJECTOR CARBONS

NATIONAL CARBON COMPANY, INC.
Post Office Box 400
Cleveland, Ohio

Gentlemen: Please send me complimentary copy of the New Handbook on National Projector Carbons.

Name________________________________

Title________________ Theatre________________

Mail to ____________________________ Street

City____________________ State____________

M.P.P.10

MOTION PICTURE PROJECTIONIST

A MONUMENT TO MOTION PICTURES

THE two Radio City theatres in New York are truly the largest theatres in the world. In all respects—design, decoration, character and size of show, operating cost, etc., they have no equal anywhere. The Roxy, which is a real picture house, is today the apex of the moving picture world.

Roxy has erected a monument to his own genius and energy but in a larger sense he has erected a monument to motion pictures, to all the brave souls who had the vision and perseverance to perfect this newest and most astounding art.

These theatres need not be the last word and for all we know may be superseded in size and grandeur before long, just as the old Roxy on Seventh Avenue has been displaced by Roxy's newest. But each new gesture is a proof of the fundamental stability of the motion picture industry and a portent of its still greater future.

All the arts have extended themselves to make their most perfect presentations there. Aside from the show itself, both houses reveal the very latest in the manufacturers' bag of tricks. Projection, under the capable leadership of Arthur Smith, will be a mark for all theatres to shoot at. The lighting of the auditorium and the stage are original and daring. Every piece of equipment is the product of the latest research in engineering and design. For a long time to come these things will attract as much attention and arouse as much wonderment as Roxy magnificent shows.

The opening of these theatres will be most auspicious. The attention of the whole world will be riveted on the event. Present will be the most celebrated figures of our time, from every walk of life. They will come to see great things and undoubtedly Roxy will stagger them with the immensity of his creations. There is enough money back of these two enterprises in Radio City to guarantee a long and exciting existence.

The first theatre, the Music Hall, is a glorified vaudeville theatre and as such cannot be considered as a motion picture house. The Roxy is a picture house and will serve as a testing ground for one of the most debated questions of our time: whether it is the picture or the supplementary show that attracts and holds patrons.

The records of today show that it is the picture. The old Roxy, at its beginning, had a series of the best pictures of its day. With Roxy's beautiful symphonic orchestra and his extravagant stage shows the old Roxy dominated the Broadway show business and set the pace for all motion picture houses. Its decline may be counted from that day when its supply of good pictures began to run thin.

Boone Mancall

JAN 13 1933

SIXTH YEAR
of
PUBLICATION

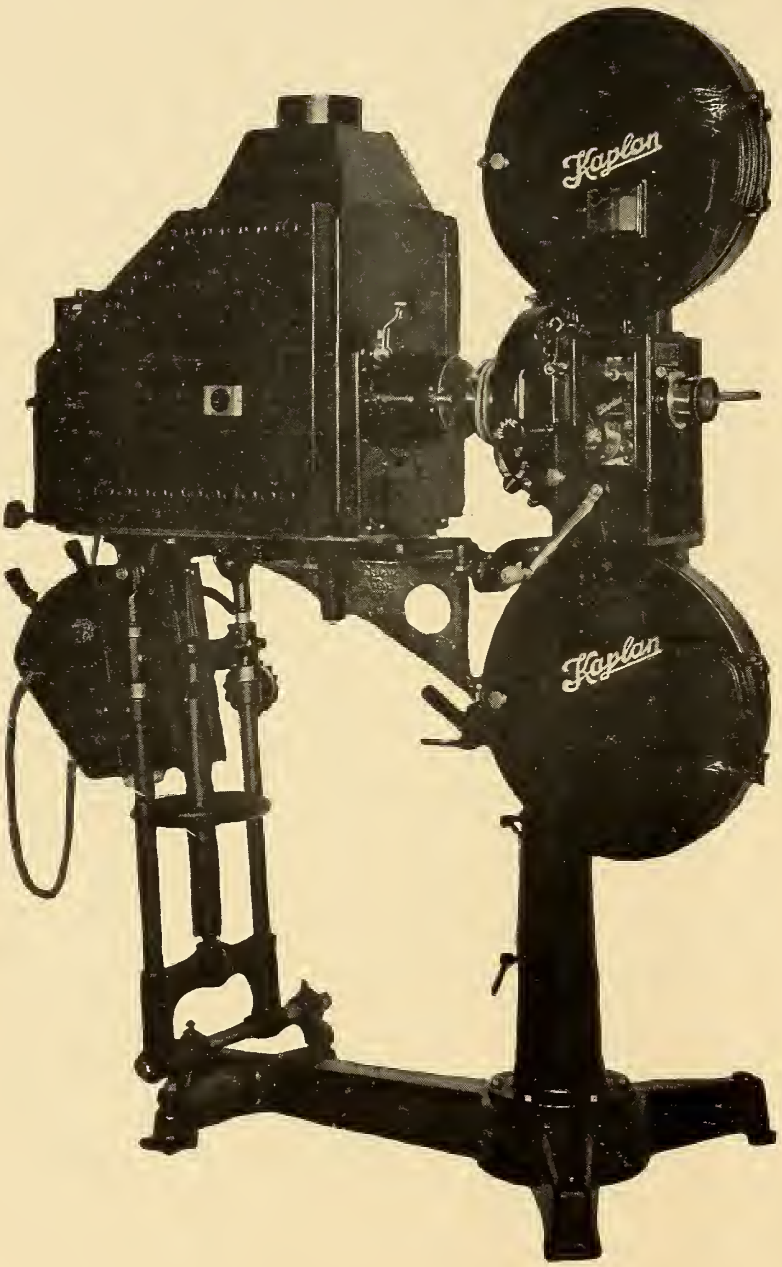
Published by the MANCALL PUBLISHING CORP., Boone Mancall, President.
Editorial and Advertising Offices, 7 West 44th Street, New York City
Entered at New York Post Office as second class matter, October 25, 1927.

Vol. 6 No. 2
DECEMBER, 1932
25c. per copy -:- $2.00 per year

WITHIN THE PHOTOTUBE
IN THIS ISSUE

Kaplan

PROJECTORS



Widely used in this country—known internationally, the Kaplan Projector is universally recognized as a product of the first rank. It has earned its reputation because it is designed and built on the best engineering principles.

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.
729 SEVENTH AVENUE
NEW YORK CITY

MOTION PICTURE PROJECTIONIST

December, 1932 Vol. 6, No. 2

EDITORIAL BOARD
Cecil B. Fowler
Robert J. Marcy
Kaskel Kallman

Published monthly by Mancall Publishing Corp., 7 West 44th St., New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue. ....Entered as second class matter October 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road,
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth Street
Melbourne, Australia.

Editorial & Advertising Offices
7 West 44th Street
New York City

National Advertising Manager
Boone Mancall

OUR PLATFORM

To maintain always the integrity of the original policy of this publication: that it be a means of raising the standards of projection by a ceaseless campaign of education among the many thousands of projectionists in the United States and Canada.

That every available inch of space in each issue be devoted to this end.

That we be interested in neither the politics or the personalities involved in the politics of the International Alliance of Theatrical Stage Employees and Moving Picture Operators or of any other group or body of projectionists, because such interference with internal affairs of labor organizations will make this a partisan and political paper and destroy its value to the craft which lies in educational work only.

That by maintaining our policy of education we will enjoy the support of projectionists everywhere for many years to come as we have enjoyed this support for the last five years as the leading projection publication in the country.

The Editors and the organizatons with which they are affiliated do not necessarily endorse all the statements or opinions offered in this magazine. The author who signs an article assumes full responsibility for the statements it contains.

HOW TO "SHOOT" TROUBLES ON YOUR PROJECTION EQUIPMENT

LAST CALL

Only 300 Copies Left.

Order Your Book Today.

SERVICING PROJECTION EQUIPMENT

A very useful book, designed and written only for the motion picture projectionist . . . as handy and as necessary as any tool . . . already many hundreds of copies are working over-time in as many projection rooms.

This book can be had today for $1.00. There are no strings attached to this unusual offer. We pay all postage.

Get your copy at once. Fill in your name and address in the coupon below, pin a dollar bill to it, insert in enveope and mail to the Mancall Publishing Corp.

CUT OUT - FILL IN - MAIL AT ONCE

Servicing Projection Equipment

Last Copies

$1.00 Only

Name ....

Street ....

City ....

State ....

Industry's New Research Council

THE Research Council has been established by the Academy of Motion Picture Arts and Science to coordinate all technical and investigational activities of the organization under one body. Each of the principal equipment and manufacturing companies dealing with the motion picture industries has appointed an engineering executive to represent the company on the Council in an advisory capacity.

The Council meets quarterly, its work being carried on by subcommittees of experts, each being appointed to deal with a specific project in its particular field. The following are the advisory members on matters pertaining to projection:

H. G. Knox, *Electrical Research Products, Inc.;* Dr. A. N. Goldsmith, *RCA-Victor Corp.;* Dr. C. E. K. Mees, *Eastman Kodak Co.;* Dr. V. B. Sease, *Dupont Film Co.;* W. E. Green, *International Projector Corp.*

According to Darryl Zanuck, its chairman, speaking at the first meeting, held in August, the job of the Council is specifically to do everything within its scope to get pictures of a better quality on the screen and to get them there with higher efficiency and at lower net cost. That, of course, is what every company is at the present time trying to do and developments in which any company has already established a real competitive advantage are not the concern of the council. It is believed, however, that there are many problems which may be handled more efficiently by the council than by a number of companies working individually and thus duplicating their efforts.

Eight committees have been appointed to investigate an equal number of problems at present existing in the field of Cinematography and Projection. The investigations relating to Projection are being conducted along the following lines:

Uniform Practice on Reel Length

Problem: In cutting, release printing, distribution, shipping and exchange inspection, the producing companies are using the reel of from 800 to 1000 feet which has been the established unit for many years. Most theatres, however, are equipped with 2,000 foot magazines and an increasing proportion are doubling up the reels for projection. The situation is complicated by the preference for longer reels among many projectionists in first run houses, by the number of theatres in which only one projectionist is employed, by the fact that studios are frequently unable to avoid issuing reels of very short length, and by the fact that the exchanges have not been able to enforce penalties against reel doubling.

By far the largest number of reprints required are for beginnings and ends of reels, and the practice of doubling is responsible for much of the mutilation of the reel ends as frames are lost every time the leaders are cut off and re-spliced. The Standard Release print assumes that reels will be projected in the lengths in which they are distributed. Its efficiency for precision change-overs is lost when the reel ends are not maintained.

Proposed: To secure further data from all companies to determine the extent of the practice of reel doubling and the annual cost to the industry. To determine the most efficient length of reel unit, from the viewpoints of production, shipping, projection and cost. To particularly investigate the feasibility of reels in lengths of 1,600 to 1,800 feet, using reels with 4-inch hubs to reduce wear on films ends. To carry on development of improved designs of shipping reels. To study disc release in relation to reel length. To propose a comprehensive program to give the industry the advantage of unified action in establishing an effective uniform practice.

Raising the Average Quality of Release Prints

Problem: Laboratories in Hollywood operated by or in close touch with the production studios have established high standards of quality and uniformity of product. In many cases release prints and replacements are made by laboratories located in all parts of the world and under present conditions no company can be sure that these wil be as good as Hollywood prints obtained from the same negative. Measuring instruments of the various laboratories are not calibrated to any common standard and specifications for optimum prints are difficult to set and enforce.

Proposed: To continue the work of the present sub-committee in the local field in formulating and giving formal recognition to those desirable standards of processing and quality as to which there is general agreement. To bring more forcibly to the attention of production executives generally the desirability of insuring that the theatre release is of as good quality as the answer print. To employ one or more technicians for specialized research under the direction of a subcommittee. To undertake a program along the following lines: Standardization of review room projection equipment. Establishment of international standard reference sensitometer. Establishment of standard means for calibrating densitometers. Further investigation of the proposal to incorporate a density spot or simplified sensitometric strip in negative leader of each reel as means of specifying print requirements.

Investigation of Film Preservatives

Problem: A number of compounds are on the market which manufacturers claim will lengthen the life of release prints, protect the surface from scratches and reduce buckling and warping. Studios and laboratories have tried these preparations from time to time and found both advantages and disadvantages, but no impartial and scientific comparative tests have ever been made.

Proposed: To test the claims for the principal preparations under practical conditions of use with high intensity projection lamp, etc., and make recommendations for the information of the studios on the basis of efficiency in relation to cost.

More Efficient Use of 35 mm. Film Area

Problem: The addition of the sound track and the changes in image frame brought about by the requirements of sound pictures have resulted in considerable areas of the standard 35 mm. film not being used. The width of the sound track is now matted off in the camera from the negative. On both the negative and positive approximately 14 per cent of the length of the film is now taken up by frame lines.

Proposed: To undertake systematic preliminary investigation of the possibilities of either using the film area or salvaging it through adaptations of equipment. To determine what possibilities are feasible from technical and economic considerations and what savings might be secured in relation to the cost of making changes.

Correction of Distortion in Projection

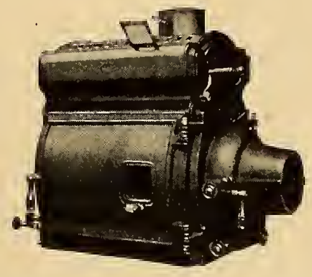
Problems Vertical distortion of the screen image because of the angle of projection has been a serious problem for many years, made more acute by the construction of large theatres with very steep projection angles. Keystone distortion, loss of image area at sides due to keystone and the uneven focus from the tilted focal plane are associated problems. Research toward the development of some prism or other optical device to correct these distortions has never been carried far enough to thoroughly test possibilities of such correction.

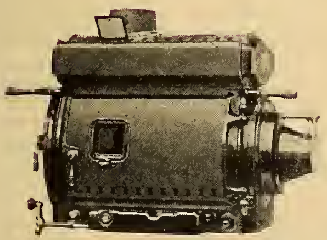
Proposed: To secure whatever data is at present available in the field. To define the objectives and indicate the principal practical problems. To sponsor further study on behalf of the industry.

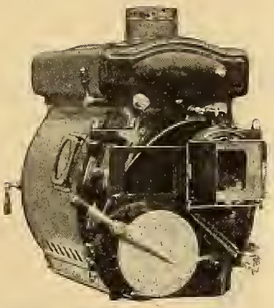
Brenkert

Projection Lamps

in theatres from coast to coast are daily producing highest quality projection at low operating cost.







Super High Intensity — Hilow — Standard Intensity

A size and type to meet any projection requirement. Sold and serviced by independent supply dealers.

WRITE FOR LITERATURE

A Brenkert PRODUCT

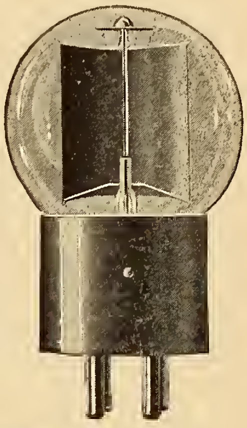
CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.

Engineers & Manufacturers

ST. AUBIN AT EAST GRAND BLVD., DETROIT

"Once Tried —Always Used"

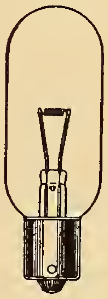


VISITRON

PHOTO CELLS

This Pioneer of sound picture photoelectric cells holds its lead by PREFERENCE! It is the preferred cell of projectionists who know real quality and insist on perfect performance. Thousands of projectionists are now using VISITRONS—because they tried them out and judged them by comparison. A similar comparative test will quickly switch you to Visitrons. Any National salesman will demonstrate gladly. Just ask him.

●



Genuine MAZDA EXCITER LAMPS

Satisfactory results from any sound equipment depends on the proper functioning of its accessories. Photo Cell Exciter Lamps are vital. Genuine Mazda Exciter Lamps should be used as a reliable precaution against trouble. National carries them in stock for you at all stores.

Ask about our FREE Equipment Inspection Service. It prevents trouble and saves expense.

NATIONAL THEATRE SUPPLY COMPANY

Branches in all Principal Cities

The Treated Screen Surface

By ALBERT B. HURLEY*

HOW may conditions pertaining to every-day visual activities be improved to enable us to see without strain or fatigue? Visual activities, of individuals of all classes, of all ages, are many and varied. We know that millions, old and young, are suffering from deficient vision today. Accepted as fact, is the knowledge that our eyesight has deteriorated rapidly since the advent of the electric or artificial light. The normal vision of the human race must be conserved at any cost. Eyes, other than normal must be protected, first by proper optical aid and glasses, and then conserved by conditions of light and stimulation within limits of normal functioning.

Inadequacy of Artificial Light

Artificial light, improved in intensity and quality since its inception, is not yet comparable with daylight. Our eyes evolved under daylight conditions, under high intensities of light of a quality or spectral character not obtainable from the ordinary artificial light sources, which in these modern times, we must constantly employ in our daily visual activities. Organically our eyes have not changed to meet conditions of artificial illumination and the nearness of the light source. This wonderful sense organ, the eye, flexible and adaptable to almost any intensity of light of a daylight character, is now subjected, most of the time, to artificial light of relatively low intensity, lacking blue and green rays and having a preponderance of yellow and red rays. We will not say that the blue and green rays are more essential or beneficial to the eye than the yellow and red rays. We do claim, however, that a light such as average daylight, having a continuous spectrum and composed of a relative even number of waves of radiant energy, is best for the eyes and will improve vision; also, that artificial lights with a preponderance of yellow and red rays, cause eye-strain and fatigue, are harmful to the eye and impair vision.

High intensities of even two or three thousand foot candle brightness of a daylight character cause only normal reaction of the pupil of the eye, while low intensities of artificial illuminants with their preponderant red and yellow rays cause glare and pupilary contraction that should and can be controlled. Brightness of the retinal image is proportional to the diameter of the pupiliary opening which we find is involuntarily controlled by quality, as well as by the intensity of the light. The small-size pupil influences definition only at very high intensities. Keeping the pupil of the eye open to a diameter of three, instead of two millimeters, under low intensities, produces approximately the same increase of vision as would result from a several hundred per cent increase in illumination.

The Treated Screen Surface

Seeing depends upon three things namely, the light source, the surface of the object being viewed and the eye itself. We cannot change the natural reaction of our eyes to light, but much can be done to improve the light to which they must adapt themselves in the function of vision.

Now, what combination of light, surface and resultant reflected light is best for the eye and will cause normal functioning, without strain and fatigue at either maximum or minimum limit adopted? The optican can keep our eyes in good condition. The physicist has given us improved artificial light and is working to perfect its quality. In working towards better vision, consideration of the surface is equally important.

A new development in this direction is the practice of treating the reflecting surface such as the printed page or motion picture screen, etc., with due consideration to the incident light and the need of the human eye, so that the surface will reflect to the eye a corrected light spectrum within limits of average daylight stimulation. If the character of the surface can be selected, so much the better. This can be done in the two applications just mentioned.

The base for a motion picture projection screen must be as diffusing as it is possible to obtain and within the limits of a so-called white surface. The better the dffusion the more perfect will be the vision for all persons viewing the picture. The writer has made a surface diffusely reflecting approximately 92% of the incident light, which may be considered as one measure of visual result in this particular application.

Intensity of artificial lights can be controlled and better visual results can be obtained by correcting or improving the quality or spectral character. Attempts to correct the spectrum of artificial lights by filters have been successful to some extent, but the efficiency of such filters is very low. Nature has given us pigments that absorb and reflect light more efficiently than any manufactured filter absorbing and transmitting light. Therefore, the practice of using such pigments on a reflecting surface to correct the spectrum, furnishes another measure of vision, the results being in accord with type and efficiency of the light used. It becomes then only a matter of choosing the best illumination intensity of each installation of a motion picture screen employing this new method.

By means of a spectrophotometer, we measure the capacity of the surface for reflecting each and every wave length in the incident light whether its source be the Tungsten Projection, the D. C. Arc or any other type of light source advocated. Knowing the radiant energy given by each of these light sources, the screen base is then treated with a selected pigment, which absorbs part and reflects part of the incident light, so that each unit of surface reflects a composite of light rays simulating average daylight. By absorbing any preponderant yellow and red rays, we accentuate the blue and green rays and make them more efficient in giving perception.

Quantity vs. Quality

A screen was constructed using one-half present diffusing type material and one-half treated screen material, each side being illuminated by a D. C. Arc projector, each arc using current of 26 amps. Attempts to match the two sides, and balance the entire screen illumination by raising or lowering arc current, were influenced by color differences. However, a near match was found by using 26 amps. in projecting on the untreated screen surface and 17 amps. in projecting on the treated surface.

A picture was then projected upon untreated screen and several observers noted brightness and definition characteristic of several values in arc current, with the result that 26 amps. were used to give satisfactory result. The picture was of a man seated at a desk and observers were each given some fine details to closely observe and to comment upon, such as the face and eyes, collar and tie, suit, pictures on wall, etc. On the treated screen the same picture gave satisfactory results at 15 amps. There was better definition and many details not noted before were readily visible, such as design in necktie, a mustache, and determination of subject in pictures on wall not known before.

Advantages of Corrected Light

Light reflected from the treated surface will normally and evenly stimulate the retina by a pre-determined period of vibratory wave lengths causing a normal functioning of all processes of the eye. This corrected light will prevent over stimulation causing the sensation to "over-shoot" its value. After-images, both positive (due to intensity) and negative (due to fatigue), will be minimized. The eye adapts itself quickly to light from a lower to a higher intensity but very slowly when subjected, first to a high and then to a low intensity.

---

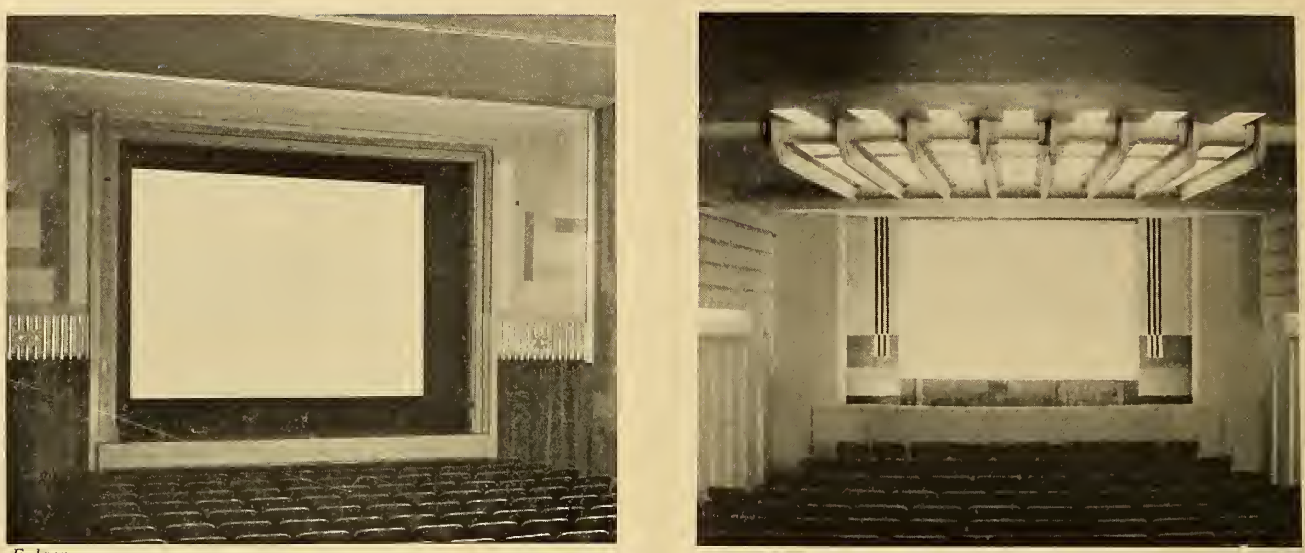
* *Inventor of Orthocrome Screen. Designer of screens in Radio City.*

DON'T

SPLICE FILM THE
OLD, MESSY WAY . . .

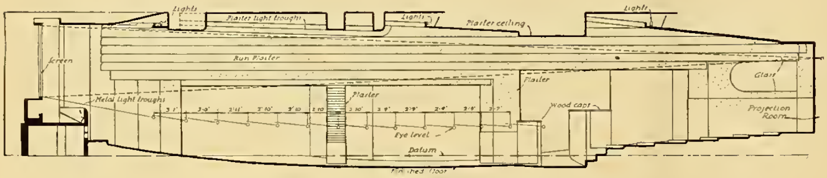
EASTMAN Sound Film Patches do the job more quickly, neatly, and dependably. Because of their design, they are practically inaudible in projection. At the same time they obscure a minimum of the sound track, and assure fast, accurate, and clean treatment of all splices. Together with their precise registration block they represent a valuable yet inexpensive feature of Eastman service to the motion picture industry. Eastman Kodak Company. (J. E. Brulatour, Inc., Distributors, New York, Chicago, Hollywood.)

USE EASTMAN
SOUND FILM PATCHES



Folger

The screen of the Thalia Motion Picture Theatre at the right shown in comparison with the blackmargined screen usually seen in motion picture houses. The absence of an obvious boundary in the new setting reduces eye fatigue and aids greatly, the illusion of space in the picture.



Sectional view of the Thalia Theatre. The reversible floor in this theatre made possible the use of a considerable part of the basement in a building where a theatre of the present type would not have been possible. Notice the low level of the projection room.

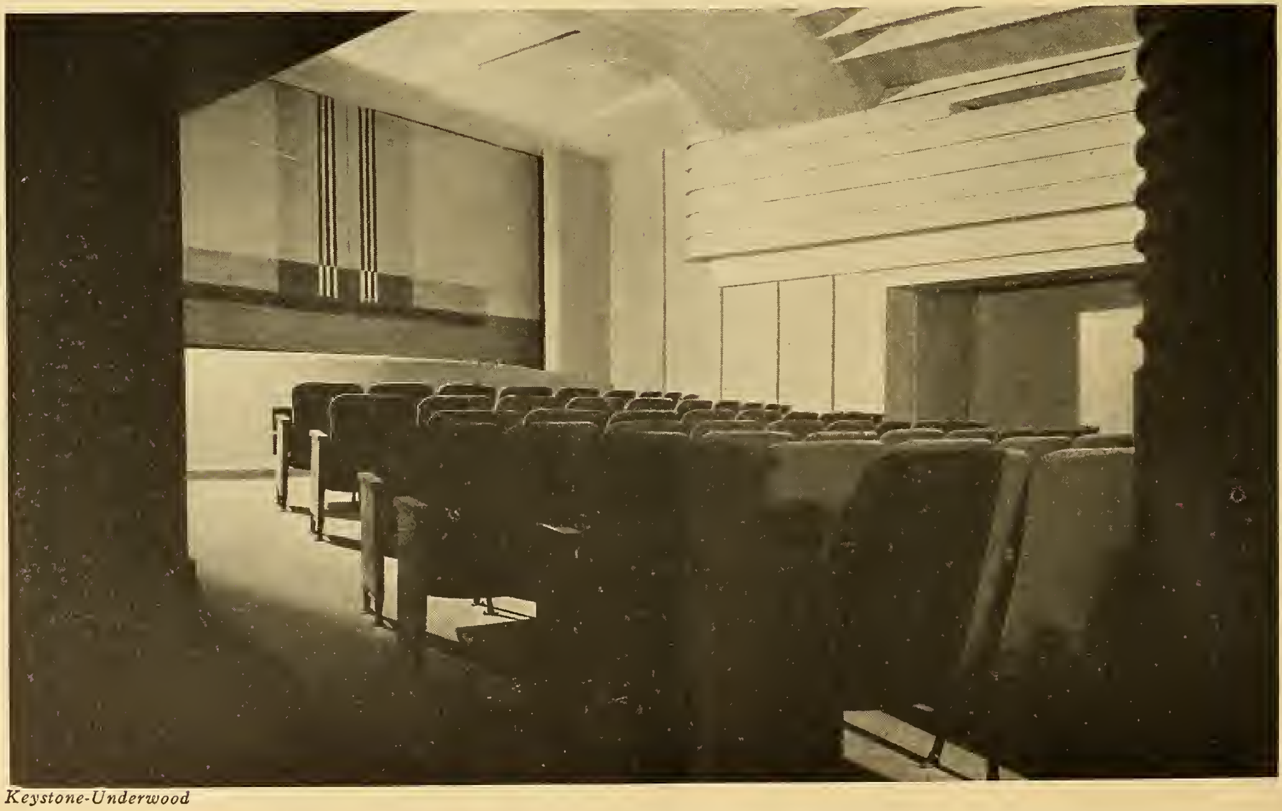
THALIA THEATRE

New York, N. Y.

Ben Schlanger and R. Irrera,

Architects.

The auditorium of this theatre has been planned for the presentation of motion pictures only ,and in its plan have been included many innovations unusual in the ordinary motion picture theatre.



Keystone-Underwood

View of the orchestra showing how the floor in this theatre slopes downward as it recedes from the screen.

The Floor and the Screen*

By BEN SCHLANGER

Mr. Schlanger an architect and a member of the Society of Motion Picture Engineers, has done much individual research on the design of motion picture theatres, the reversed floor described in this article being his own development. It is Mr. Schlanger's contention that the motion picture auditorium of today owes its inadequacy to the design inherited from the legitimate theatre. In this article the writer analyzes the difference in viewing a scene on the stage and one in a moving picture. That such difference exists and that it presents a problem that heretofore has been given little capable attention, is suggested forcibly to the patron who occupies one of the only remaining seats during a popular picture.

THE motion picture as a form of entertainment has made notable strides in recent years. It is the dominant instrument which brings to the masses, in remote as well as in centralized locations, an effective theatre art, heretofore out of reach. It is only in the past few years that the motion picture has, due to many technical developments, proved itself a form of the theatre arts that is worthy of a home or structure specially designed for its needs.

A survey of the policies of theatres now in use would probably show that most of them are devoted to the exhibition of motion pictures exclusively. Many of them at one time housed a combined entertainment of legitimate stage performance and the motion picture. The feeling that the motion picture was merely an added attraction may explain why theatre structures today are unsuited for proper motion picture exhibition.

Although the requirements of vision, of acoustics, and of the comfort of the patron are important in the planning of the legitimate theatre, it will be found that these requirements are subject to a more precise adjustment in the case of the motion picture theatre. The sounds and dialogue, now part of the motion picture, have a broader range of frequencies and volume than can ever emanate from a legitimate stage performance. This makes the problem of acoustics in the cinema a relatively more complex one and requires a more delicate adjustment of the form and treatment of the theatre interior.

Basically, however, the acoustical requirements of the cinema and of the legitimate theatre are similar, differing only in degree. It is the requirements of proper vision of the screen in the cinema which differ entirely from the requirements of vision of the legitimate performance. If necessary, acoustics in the legitimate theatre could be improved to accommodate the audible screen performance, but in the matter of proper vision the very form of the legitimate theatre structure is basically unsuited for, and difficult to adapt to motion picture presentation.

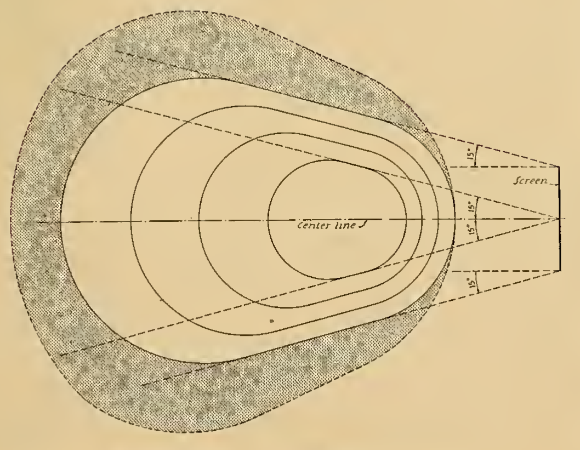
Restriction of Two Dimensional View

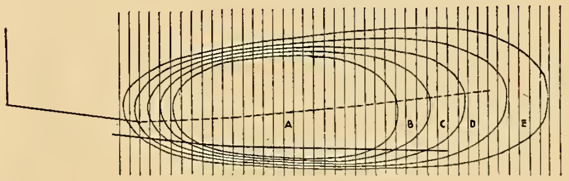
Viewing a stage performance is similar to observing images, background, etc., in real life. The performance, or that which is being viewed, holds a particular position and the spectator may be in any arbitrary position in relation to that which is being viewed. In any one of a variety of locations, the spectator receives his own particular perspective view of the performance. One view may be different from or better than another, but each still has its interest and value for the viewer. In the cinema, the camera becomes the many eyes of the spectator; it commands not only one perspective view of the performance, but many more impossible for the spectators of a stage, and transposes them on to a two-dimensional surface, the motion picture screen.

The spectator's position for viewing the screen performance is not an arbitrary one, as it may be in the legitimate theatre. He must be seated within a confined area suitable for viewing the two-dimensional screen surface. The view obtained by each spectator of the screen is a similar one, for the perspective effects that would be seen from different vantage points in real life or on the legitimate stage have already been achieved by the moving eye of the camera. This means that the spectator's view of the screen images already thrown into perspective must not be additionally foreshortened or converged. A distorted view of the two dimensional picture surface with images and background already thrown into perspective is very disturbing to ocular and physical comfort.

The author has developed two charts indicating the areas in the motion picture theatre which are usable for proper vision of the motion picture screen. Chart No. 1 determines the usable areas in the horizontal sense (plan view). Chart No. 2 determines the usable areas in the vertical sense, representing a longitudinal section taken through a motion picture auditorium. The shaded portions in both charts indicate areas which are commonly used in many theatres but afford only very poor seating positions from which spectators obtain a distorted view of the screen image.

Figure No. 1 shows how a distorted view of a human figure results from the poor position of the spectator in relation to the screen. Dimension A is the full width of the human figure





These two charts illustrate graphically the usable areas for proper vision in a motion picture theatre. Chart No. 1, at the left, determines the usable areas in a horizontal sense (plan view). The shaded portion indicates areas commonly used by affording poor seating positions. Chart No. 2, above, determines the usable areas in the vertical sense.

---

* By permission of The Architectural Forum.

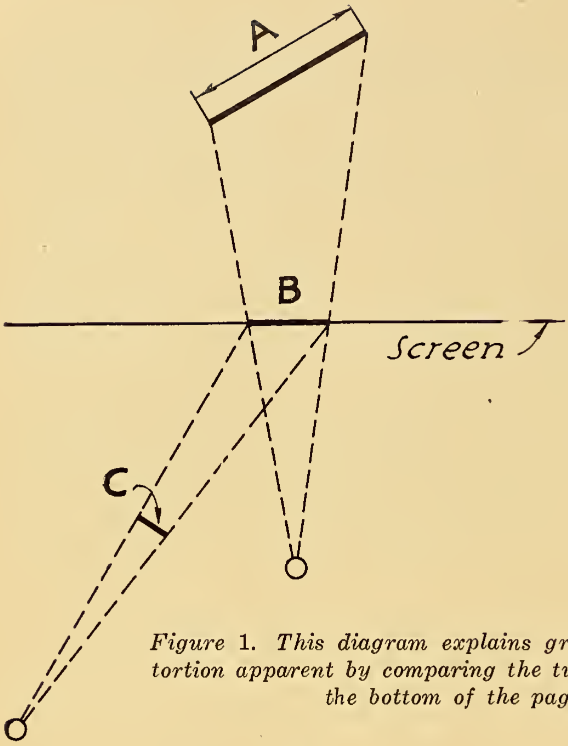


Figure 1. This diagram explains graphically the distortion apparent by comparing the two illustrations at the bottom of the page.

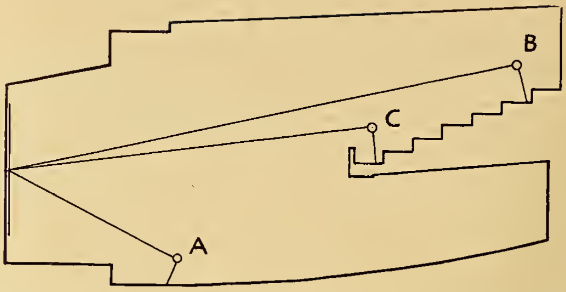


Figure 2. A diagram of the typical theatre with the usual sloping floor and high balcony. Spectator "A" must tilt his head backward in order to view the upper portion of the screen. The steep angle of the balcony makes it necessary for "B" and "C" to lean forward in order to view the screen.

(plan view). Dimension B shows the foreshortening of Distance A due to the particular perspective view the motion picture camera has obtained—a view similar to that obtained by the spectator in a similar position in the legitimate theatre. Distance C represents Distance A decreased, first, by a natural foreshortening (due to the camera angle) and, secondly, by the poor position of the spectator in relation to the motion picture screen. It is easily seen that if Distance C must represent Distance A, the result can be only a distortion of the image.

Distorted views of forms and background on the screen are accented most when the forms of background appear in sharp perspective. A view taken in sharp perspective in motion picture work is one of the most forceful and effective instruments of the motion picture art. Thus, it is necessary that the means of exhibiting must be allied with the production of the motion picture itself.

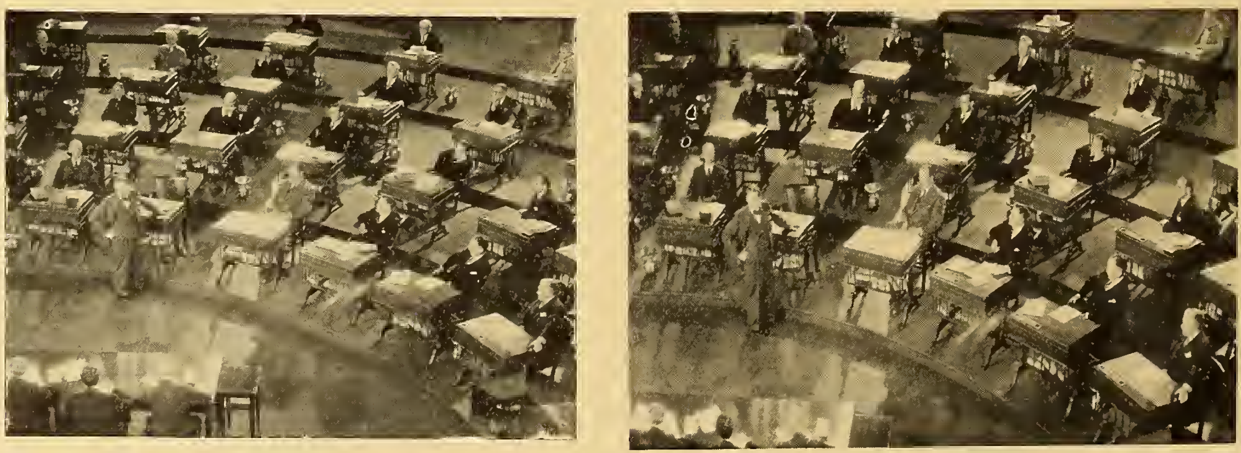
The comfort of the patron also requires more careful attention in the cinema than in the legitimate theatre. The spectator in the cinema must be at ease and must feel neither bodily nor ocular discomfort. This is essential to help complete the illusion of realism desired, despite the fact that the images on the screen have technically only two dimensions.

Seats and Sight Comfort

The comfort of the patron depends upon the seating arrangement, which involves chair spacings, aisle arrangements, and the floor slopes and the balcony pitches. Chair spacing and aisle arrangements are largely controlled by the local building ordinances and the economies of space utilization for each individual project. But a more important and heretofore neglected consideration is the seating arrangement as it is affected by the needs of ocular and bodily comfort. A scientific adjustment of the floor slopes, balcony pitches, sightlines and individual chair back pitches is needed to insure the patrons' comfort.

The floor that slopes up from the stage has been commonly used to gain unobstructed vision and has served its purposes so far as the needs of the stage performance were concerned. However, this type of floor is not efficient for the cinema; first, because it does not allow for the designing of the seating areas within the confines from which the screen may be properly viewed, and, secondly, because it does not permit the use of proper seats and chair back angles needed for the spectator's comfort while viewing the entire height of the motion picture screen.

On the orchestra floor level, the present arrangement of floor slope requires (except at the extreme rear of the auditorium) that the spectator tilt his head backward to see the upper portions of the screen, in some



Courtesy of Motion Picture Herald

These two scenes from a motion picture, "The Washington Masquerade," illustrate (at the left) a direct view and (at the right) a distortion of the same scene if viewed from a position outsde an area 15 degrees to a perpendicular erected at the edge of the screen. A similar distortion takes place above the 15 degrees vertical maximum for good vision.

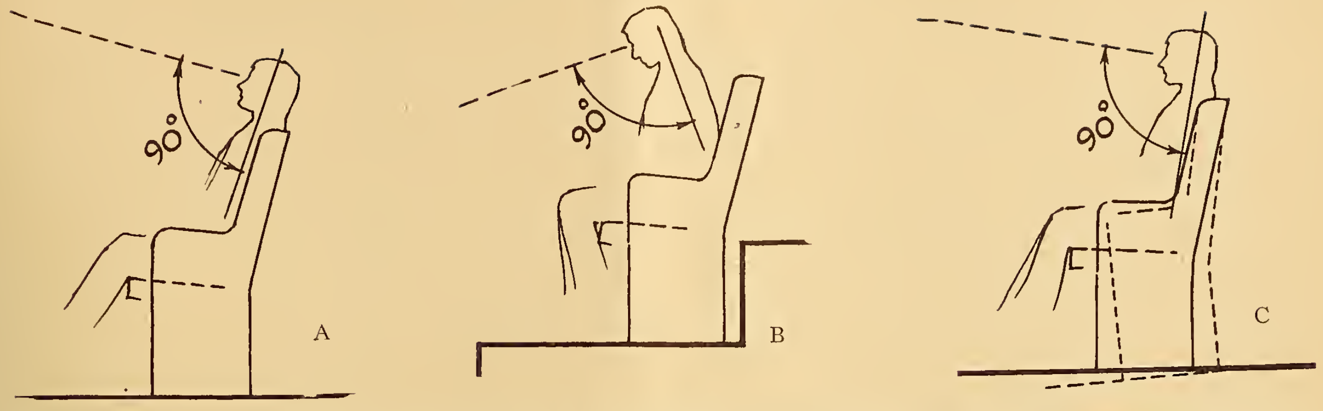


Figure 3. Scientific adjustment of the floor slopes, balcony pitches is needed to insure the patron comfort. In "A," the spectator is forced to assume an unnatural head tilt in the orchestra. In "B," his position is uncomfortably reversed in the balcony. "C" illustrates the comfortable position assumed on a horizontal floor with a reversed pitch.

cases to a somewhat painful degree. In the balcony the steep angle makes it necessary for the patron to pitch his body forward away from the support of the back of his chair in order to view the screen which, in most cases, is at a level below that of a greater part of the balcony or balconies.

The Reversed Floor

The parabolic reversed floor system corrects all of the faults which become evident when the present type of theatre structure is used for motion picture exhibition. This new system brings the high point instead of the low point of the floor nearest the screen. This permits a systematic tilting of the backs of the chair on the reversed orchestra floor slope. By tilting the body backward to a specified pitch in each row and permitting the higher part of the floor in front of the seat to support the feet, a natural and comfortable position is assumed which allows the spectator to obtain a complete view of the screen without having to raise his head from its natural position. Seats on the orchestra level more remote from the screen require less tilt.

The angle of tilt in each case is perpendicular to a line of sight drawn from the eye level to a point on the screen about one-half its height from the lower edge. This is the area of maximum action where the spectator's eyes are most usually focused. The angle formed between the back of the chair and the seat is 98°. This is a constant for every chair, because it has been found most conducive to a correct and restful posture. Heretofore, only the position of the seats and the screen were taken into consideration in determining sightlines, the matter of posture being entirely disregarded. The screen itself is raised to a prescribed height above the level of the eye line of the front row of seats nearest it. The reverse slope of the orchest floor permits establishing a definite relation between the inclination of the floor and that of the seat and the position of the screen. It would be impossible to apply this system of tilting to the present slope of the orchestra floor because the proper angle of the seat with respect to the back of the chair could not be maintained without leaving the feet unsupported. Sightlines from the orchestra level cannot, therefore, be improved for screen entertainment unless the slope of the orchestra floor is reversed.

While this arrangement distinctly improves the orchestra seating, it also serves as a means by which the complete form of the theatre may be revised to suit the requirements of the screen performance. The faults of the present orchestra seating are greatly magnified when the enlarged screen is used because the spectator then has to tilt his head backward even farther than it is now necessary with the small screen. And so the enlarged screen has also served as an important agent in determining a new form for the theatre structure.

Reversing the slope of the orchestra floor also brings many decided advantages to the balcony, which can now be kept low and of a slight pitch, made possible the low point of the rear of the reversed orchestra floor. The balcony thus becomes more desirable for two reasons: (1) due to the fact that the level of the screen is very much the same as that of the balcony, the sightlines are greatly improved, and (2) direct and easy access to the balcony from the street level is provided, the difference in levels being surprisingly small, compared to the difference in these levels to the usual theatre.

A complete analysis of bodily posture has been made in connection with the parabolic reverse floor principle; the maximum and minimum angles at which the spectator may comfortably repose in seats placed on the different portions of the orchestra floor and on the balcony and yet maintain ocular comfort. It is of no value to be seated comfortably if the eye must be strained to see an image placed out of the normal range of vision. To avoid this fault in seating design, the author has correlated the factors of the normal range of vision and good bodily posture.

The Flat Floor and Its Relation to the Reverse Floor

The problem of exhibiting motion pictures in an auditorium having a flat floor presents itself when an auditorium (in institutional and non-commercial structures) is designed for multiple uses. While it is possible to exhibit motion pictures under such conditions, it can be properly accomplished only by a highly inefficient use of floor area. For example, in a room 30 x 80 ft., with a screen placed 4 ft. away from the end wall for the amplifying horn, only about one-half of the depth of the room is usable for proper seating. To make these seats usable, it is necessary to raise the position of the screen sufficiently to allow vision of the bottom edge of the screen from all seats. This renders the front half of the room near the screen unusable for seats, due to the high position of the screen which produces distorted screen images in relation to the low level of the floor at the screen end.

The reverse floor principle is an evolution of this factor of gain in the vertical range of vision due to increased distance from the screen and it is therefore an evolution of the flat floor rather than an improvement of the commonly sloped orchestra floor. The basic foundation of the parabolic reverse floor principle is the position of the screen in relation to the gain in the vertical vision due to distance from the screen. The position of the screen and degree of the reverse slope (which controls the angle of chair back tilt) can be determined, however, only from a thorough analysis of all the factors involved. (See Figure 4.)

Screen Size, Proportion and Third Dimensions

The screen is the motion picture stage. It is the nucleus of the whole theatre design, the point around which the whole theatre should be built. The dramatic effect of the screen performance on the spectator has yet to be thoroughly analyzed. The screen as it is presented in today's cinema is still an obviously framed picture instead of a space into which we peer, seeing the

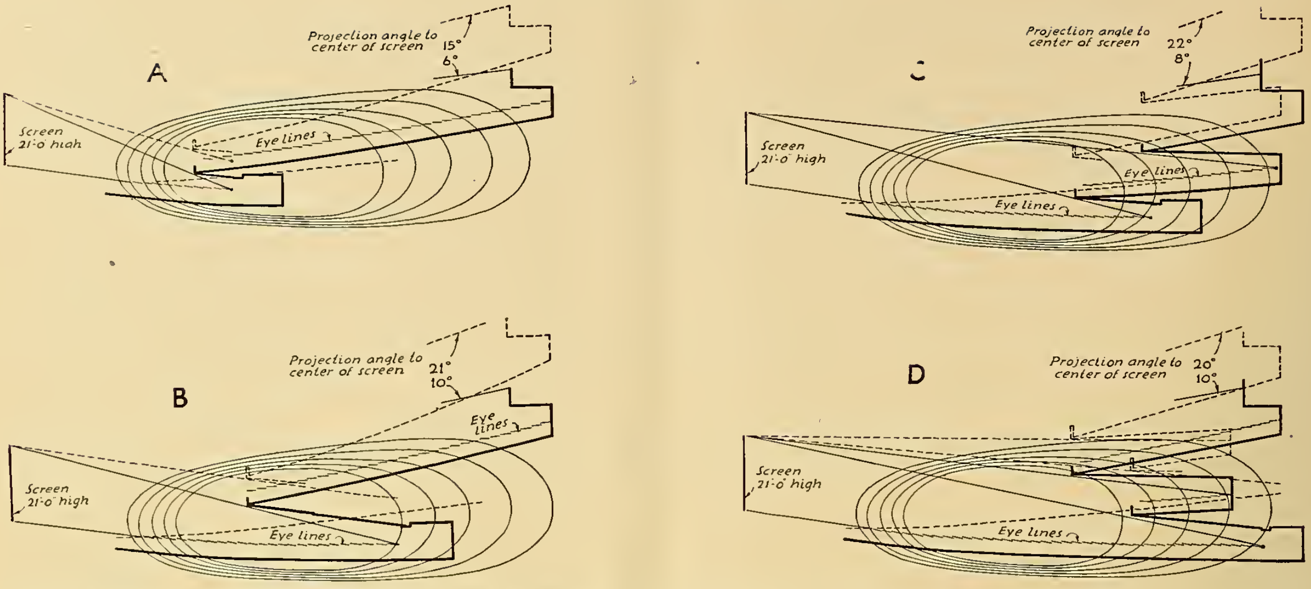


Figure 4. These four diagrams illustrate the economy of space which may be achieved by utilizing the parabolic reverse floor system. The dotted section lines show the orchestra and balcony floors of four common types of motion picture houses. The heavy lines show that with the parabolic reverse floor tho capacity of the theatre may be maintained, the visual efficiency raised and the comfort of all spectators greatly increased.

projected other world of the cinema. To achieve this much-desired effect, the scientific development of the third dimension effect on the screen is a primary necessity. This, however, implies many technical difficulties, and until they are overcome, other means at present more available must be used to increase the screen illusion of space reality. Upon these means, namely, the proper size, proportion and framing of the screen, depends the effective delivery of the performance to the spectator.

A maximum size screen is desirable. It should, if possible, dominate the whole forward portion of the auditorium. The spectator can thereby be made to feel that he is actually encompassed in the action which he views. The maximum size screen also enlarges the scale of images and backgrounds in relation to the spectator, thereby heightening the dramatic effect.

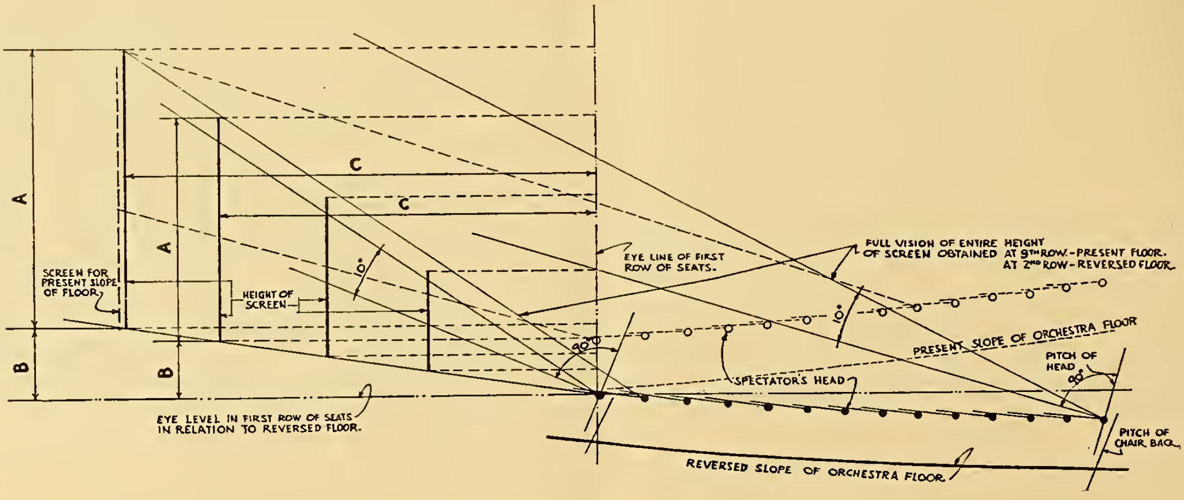
The size of the screen is dependent upon (1) the width and depth of the auditorium; (2) distance sacrificed between the screen and the first row of seats; (3) distance from the screen to the row of seats furthest from the screen; (4) the location of the balcony facia or facias fixes the maximum height of the screen (the usual large overhanging balcony limits the height of the screen); (5) the shape of the screen; (6) the width of the motion picture film (at present 35 mm.; a 50 mm. width is now being considered); (7) projection lens size; (8) length of throw from projector to screen.

The present type of theatre structure cannot accommodate a large screen. There may be sufficient space in the proscenium opening, but balcony obstructions and unsuitable floor slopes afford vision characteristics which are adaptable only to the smaller screen now in use. A maximum size screen is very readily usable in a theatre with reverse slope floor.

The proportion of the screen is an important factor in cinema design inasmuch as it controls the size of the screen. For example, the height of the screen should determine the slope and position of the floors and balconies, the shape of the auditorium, the location of the projection booth, the seating arrangement, and the chair back pitches. The width of the screen determines distance B and C shown on Chart No. 1. It is therefore necessary to investigate screen proportions before planning the cinema auditorium.

Screen Framing

Motion picture screens are commonly framed with a black velvet masking placed directly in front of the white sheet to insure a steady, sharp edge for the picture. The fuzzy edge of a magnified light source and the slight shifting of the picture due


A
A
B
B
C
C
SCREEN FOR PRESENT SLOPE OF FLOOR
HEIGHT OF SCREEN
10°
EYE LINE OF FIRST ROW OF SEATS.
FULL VISION OF ENTIRE HEIGHT OF SCREEN OBTAINED AT 9TH ROW.-PRESENT FLOOR. AT 2ND ROW-REVERSED FLOOR.
10°
90°
PRESENT SLOPE OF ORCHESTRA FLOOR
PITCH OF HEAD
90°
SPECTATOR'S HEAD
EYE LEVEL IN FIRST ROW OF SEATS IN RELATION TO REVERSED FLOOR.
PITCH OF CHAIR BACK
REVERSED SLOPE OF ORCHESTRA FLOOR

Comparison of sight lines from orchestra seats with present and reverse types of floors.

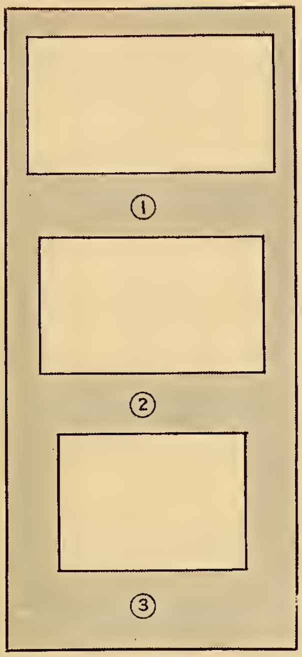


Figure 5. Three proportions for moving picture screens. No. 1 has a proportion of 1 to 1.8 and accents the horizontal direction. No. 2, having a proportion of 1 to 1.67, permits both the vertical and horizontal directions to be well balanced for picture composition and may be modified to achieve any desired shape. No. 3, the present screen, accents the vertical direction. No. 1 and No. 3 are not susceptible, to changes in shape, because a modification would result in too great a reduction in the picture size.

to vibration in the projection machine is invisible to the spectator because the black masking absorbs a few inches of spilled light all around the screen. However, because of contrast, the eye is always somewhat conscious of the frame, instead of the picture image only. The result is distraction and eye fatigue. In addition, the obvious frame of this type of masking destroys the illusion of space realism so much desired.

The illuminated screen and its surrounding surfaces should appear as an even tone of light stretching from side wall to side wall. The screen image in effect should blend into the side walls and ceiling, for the obvious architectural proscenium frame is useless and detrimental to the screen performance. This portion of the cinema is subject as yet to some important study relative to the transition between the audience and the performance.

A recessed masking was employed by the author in the design of the Thalia Theatre, in New York, to decrease the sharp contrast heretofore mentioned. A haze of light around the screen projected from the side wings was used.

Maximum Projection Angle

In the placing and planning of the projection room, particular construction must be given the projection angle due to the position of the booth in relation to the screen. Most booths are placed at a level over the top of the high point of a balcony. This implies excessive projection angles which produce distorted screen images. A projection angle of 18° taken from the lens center of the projection machine to a midway point on the height of the screen is suggested as a maximum angle to avoid distortion.

Criticizes Care of Film in Exchange

Direct cost of film damage, due to insufficient care in handling, amounts to hundreds of dollars yearly, while the indirect cost, represented by increased box-office receipts that would be realized if the causes of the first loss were correct, might be reckoned in the millions, declares Dr. Alfred N. Goldsmith, president of the Society of Motion Picture Engineers, in a summary of his organization's activities written for the forthcoming 1933 *Film Daily Year Book.* Discussing this subject, Dr. Goldsmith says in part:

"It is an unaccountable anomaly that enormous amounts of money, time and energy have been expended in conducting the work of the studio, stage, recording laboratory, and processing laboratory, and so relatively little attention has been paid to the care and maintenance of film in the exchanges and the projection rooms and in the process of projection itself. In other words, the industry has been content to allow much film to be abused and misused, to be improperly projected, under poor conditions or by inadequate projectors, largely vitiating all the effort that went into the making of the film before its release by the laboratory. . . . There is no doubt that such conditions contribute appreciably to the dissatisfaction of the patron with the performances he witnesses and to his unwillingness to return again to leave his mite at the box-office."

The Projection Practice Committee of the S. M. P. E. has been investigating causes of film mutilation and endeavoring to find ways to prevent it.

STUDIOS this week were asked by the Academy to insure a closer observance of the recommendations of the Uniform Aperture Practice, which was adopted in February of this year. Particular stress has been laid upon having cameramen handle composition so that projectionists in theatres can "frame" from the top without losing any pictorial values.

The Academy's reminder was sent to studio executives and technical department heads after the organizations had been advised that the composition in a number of recent releases had not conformed strictly to the recommended practice, which is based upon "framing" from the top in the theaters.

R C A Announces New Sales Plan

INSTEAD of licensing for a ten-year period,—the practice heretofore maintained by the leading manufacturers of sound reproducing equipment—outright sale, the elimination of contract service as soon as apparatus is fully paid for and further reduction of contract service in cases of deferred payments, has been decided upon by the RCA Victor Company, which recently announced the development of its new high fidelity apparatus.

An announcement covering the fundamentals of this wholly unexpected and quite surprising move was made recently to representatives of the motion picture trade papers and executives of exhibitor associations by the Photophone Division of the RCA Victory Company at the latter's New York office on Fifth Avenue.

Ever since sound pictures replaced the silent screen, manufacturers of reproducing apparatus have leased their equipment to exhibitors for a period of ten years. Some companies also required the exhibitor to accept periodical service at specified rates for the entire term of the contract. In 1929 RCA Photophone revised its service policy so that in no case was an exhibitor required to accept service for more than three years and last year, in addition to making a marked reduction in contract service charges made the maximum period two years on the larger sizes and one year on the smallest.

"It is the company's conviction that this new policy will be highly acceptable to all exhibitors," the announcement stated. "Under its provisions, once the terms of the contract are met, whether they provide for cash or deferred payments, the equipment belongs to its purchaser. Service will be optional with him. Our experience leads us to believe, at our very reasonable rates, he will want regular service, but he does not have to take it. In this connection, to protect and supervise our property, we make one necessary reservation, namely, under the deferred payment plan. When deferred payments cover a one-year period, six months service is required. Under the two year plan, one year service, and under the three-year plan, eighteen months' service. We specify periodical scheduled calls, averaging from one to two calls per month, dependent upon the type of equipment. Of course, we always stand ready to render emergency service at rates currently maintained by our installation and service department which has stations in various parts of the country."

Within the Photo Tube

By EARL D. WILSON, PH.D.*

THE life stream of the phototube is made up of minute corpuscles called *electrons,* the ultimate units of negative electricity. These are released from the cathode in numbers proportional to the intensity of the incident light flux and, under the driving force of applied voltage, are projected to the positive terminal with a speed which averages more than a million miles an hour in a typical vacuum tube. Thus it has been estimated that about a hundred-millionth of a second is required for electrons to traverse the empty space between cathode and anode. However, no one has ever been able to measure any lag between the flash of a light and the current response of a vacuum phototube. As far as the behavior of the electrons themselves is concerned, phototubes are, for all practical purposes, absolutely instantaneous in their response.

If a typical vacuum tube is placed in a typical sound projector, the maximum change in current due to the modulation of light will not be more than about 0.5 microampere. This produces a signal voltage which is not high enough above the noise level to be suitably amplified without annoying precautions and expensive circuit modifications. The same tube, if filled with a low pressure of an inert gas, will deliver under precisely the same conditions a current 5 to 10 times as great. For this reason, and for this reason alone, gas tubes are invariably used in sound projectors. It is our chief intent to explain why a gas tube delivers more current than an equivalent vacuum tube and to discuss the effect of this increase in magnitude of current output upon its quality with respect to fidelity of reproduction.

To follow the role that gas plays in a phototube, it is essential to understand the electrical structure of matter. It is well known that all matter consists of elementary particles called *atoms.* Atoms are themselves miniature systems containing equal numbers of positively and negatively charged corpuscles in dynamic balance. The positive units are known as *protons,* while the negative ones are identified with the familiar *electrons.* The core or *nucleus* of the atomic system is composed in general of a plurality of protons and electrons tangled in an extremely compact blur of motion possessing an excess of positive charge, while the outer region contains only electrons executing elliptical orbits about the nucleus in much the same fashion as the earth and the other planets revolve about the sun. But the periods of the electrons are incomparably shorter than those of the planets. As a matter of fact, the orbital electrons speed around their circuits thousands of trillions of times a second. As far as human comprehension goes, each orbit is equivalent to one continuous electron streak like the trail of a fire brand whirled in the air.

Normally there are just sufficient electrons in the orbits to balance the excess positive charge on the nucleus. Hence every normal atom is residually neutral and behaves in a field of electrical force just as though it were not made of electricity at all. Every chemical atom is built up in the same general manner, each element differing from other elements only in the relative number of protons and electorns in the nucleus and in the numbers and arrangements of the external orbits. If, by any chance, one of the outer electrons should be removed from an atom, the atom then has a residual charge. In this condition it is called an *ion.* The process of removing the electron is termed *ionization.* An ion is subject to a force when placed in an electric field and will move with an acceleration determined by its mass toward the negative terminal. Being thousands or tens of thousands of times more massive than electrons, ions will travel proportionately less fast. Once having attained to a given velocity, their momentum will be proportionately greater and collisions will be immensely more violent.

Knowing the electrical nature of matter, it is relatively easy to explain how the atoms of gas in a phototube can contribute to the total flow of current initiated by flux of light.

First, it should be understood that there is no such thing in actual practice as a perfect vacuum. A so-called high-vacuum phototube may have a residual pressure of gas equivalent to one billionth of an atmosphere. This may appear to be vanishingly small until one considers the truly incomprehensible number of gas atoms originally present in a cubic centimeter at atmospheric pressure, actually more than 10 billion billions. Thus in the vacuum tube there are still 10 billion atoms for each bit of space no larger than a thimble! At ordinary temperatures the atoms are dashing about like a crazed swarm of bees, colliding against one another many times a second, ricocheting at speeds greater than of bullets. Yet so infinitesimally small is the jot of space occupied by an atom that the average distance between atoms is 15 thousand times their diameter. It thus occurs that, on the average, an atom will travel as far as 25 feet before crashing with one of its fellows. This average distance between successive collisions is called the *mean free path* in the gas. If an electron is set in motion through this hailstorm of activity, its diameter is so much smaller that its mean free path will be even decidedly longer than for the atoms themselves. This all applies to the residual gas in a high-vacuum phototube. It is plain to see that such a tube does not owe its characteristics to the absence of gas, but simply to the fact that the mean free path of electrons ejected from the cathode is very much less than the distance between electrodes, so that the probability of an electron smashing head-on into an atom is quite remote. The tube functions electrically just as though the residual gas were not there!

In a "gas" phototube the gas pressure is designedly fixed at a value 100 times as great as that remaining in vacuum tubes. In a typical gas tube the pressure is roughly a ten-thousandth of an atmosphere. Hence, the mean free path is shortened enough for an average electron to suffer one or more collisions with an atom in accelerating from cathode to anode. What happens when a collision does occur? That depends on the violence of the encounter. The atoms themselves are banging against one another every millimeter or so of their paths and nothing happens. Even with their bullet speeds, they do not have enough kinetic energy to do any damage. To use the phraseology of the pugilist, they are simply sparring in the center of the ring. It requires a definite minimum energy of impact to jolt loose an electron from an atomic orbit, and unless the colliding assailant attains to this energy, the two will simply rebound like tennis balls to jostle or collide with other fellow atoms in an endless, untiring frenzy of action. An electron, however, has a remarkable advantage. Bantam-weight though it is, it possesses an uncompensated charge and is driven into high acceleration by the voltage field. By the time it actually confronts an atom, it may easily have acquired sufficient energy to knock an electron out of the system. Then there are two free electrons where only one was before. These two tackle two more atoms with similar results, and four free electrons dash on toward the anode goal which is drawing them through the opposition. The single electron which sprinted away from the cathode is accompanied by a geometrically increasing group of companions. Usually the anode is reached before the progression has mounted very high. This is the simplest aspect of the magnification of photo-current due to the presence of gas, but there are other interesting facts to be considered.

---

* *Research Engineer, Westinghouse Electric & Manufacturing Company.*

It can be clearly seen now that if the gas pressure is too great, the number of collisions will be so frequent that an electron can not possibly acquire momentum between encounters to ionize the atom, unless the driving voltage is correspondingly increased. If the gas pressure is too low, the electron may not even hit an atom on the entire journey to the anode, and again no ionization results. For the convenient applied potential of 90 volts, a typical phototube is filled with approximately 100 microns (0.1 mm.) of gas to produce maximum efficiency of ionization. In other words, at that pressure the average electron barely acquires the minimum kinetic energy for ionization just before actual impact.

So far, the atoms which have suffered ionization have been ignored, but it is important to consider their immediate behavior. These atoms are now ions and are subject to the driving force of the field, but in a direction opposite to the travel of the electrons. Three things may happen to any of these ions. First, either a primary photo-electron or an electron disengaged from a fellow atom may be met having sufficiently low energy for it to be drawn into the empty orbit. The ion would thus have its charge again neutralized and would be once more a normal atom among its neighbors. Secondly, the ion is still subject to the frantic jostling of the swarm so that in less than a thousandth of a second it might easily reach some part of the tube where it could pick up a spare electron and resume its usual life history. Thirdly, the ion could be hurried along in the field toward the cathode and plunge against the sensitized surface. It is this last course which is of interest. The ion, in a field of usual strength, will shoulder its way among its neutral fellows, always being interrupted, but finally arriving at the cathode with a modicum of energy left. It is much easier to dislocate an electron from the cathode than it is from an atom of the gas, since even visible light frees them copiously. Hence the ion need not have a great residual of energy in order to knock out one or more electrons from the cathode in addition to grabbing one to fill the emptied orbit. These fresh electrons are added to the total transfer of current just as though they had been released by the light flux. Primary photo-electrons, the companions they rob from the atoms, the extra ones jarred out at the cathode by some of the resulting ions all add together to make the current several times what it would be in an equivalent vacuum tube. It is evident that for a given set of values of light flux, applied voltage and other parameters, there will in general be set up an equilibrium value between the rate of recombination of ions with electrons so that a definite value of the current will result.

NOTHING has been said so far concerning the kind of gas used in a phototube. Obviously it must be chemically inert since the alkali elements used in sensitizing the cathode are the most active of all substances. In the modern cesium-oxide tube there are only five possible gases which can be employed: helium, neon, argon, krypton and xenon. In order to ionize helium, an electron must accelerate freely through a potential difference of at least 25.6 volts. This minimum voltage is defined as the *ionization potential* of the gas. The ionization potentials of the other gases decrease in the order named to xenon, for which it is only 11.5 volts. It is convenient to use as low a voltage across the tube as possible, and for this reason xenon and krypton would be preferred, but they are so rare as to be prohibitively expensive. Thus a compromise is made on argon which is relatively cheap and has an ionization potential of 15.1 volts. Argon is also chosen for another reason which will presently appear.

Consider a fixed light flux entering a vacuum phototube. For zero voltage between anode and cathode, only a very small current will flow. As the voltage is increased, the current rises steply and almost linerally for the first few volts and then increases less rapidly, approaching close to saturation value at about 15 volts. Any further increase in applied voltage has a negligible effect on the current. In a gas tube, the initial part of the curve is quite similar to that of the vacuum tube, but at about 25 volts the current for the given light flux again begins to increase rapidly until at 90 volts the amount may be from 5 to 10 times the value at 15 volts. If the voltage is continuously increased beyond 90 volts, the current rises more and more steeply until suddenly at, say, 125 volts a blue glow appears in the tube and the current, if not limited by a series resistance, would jump to amperes, and the sensitivity of the tube would be ruined. It is not safe to exceed voltage ratings recommended by the manufacturer. Even with a limiting resistance, the sensitivity rating is likely to be seriously changed by a glow discharge. What causes this failure? This happens when the positive ions, which normally collide elastically with other atoms, are accelebrated faster and faster by the rising field strength until they are ultimately able to acquire sufficient momentum between impacts to ionize just as well as the electrons, and in addition collide more frequently. The result is like pouring gasoline on a smoldering ember. Ionization rates grow exponentially so that the effective resistance between anode and cathode becomes very small. The visible glow is caused by the sum total of radiation from the electrons recombining with ions to form neutral atoms again. It is clear, however, that the tube will behave in a stable manner if the applied voltage is kept well under the glow value.

Does the gas tube suffer in some other electrical characteristics to compensate for the magnification of current? In general, with respect to sound reproduction, it does suffer in two ways. First, in regard to *linearity of rosponse to changes in intensity of the light flux;* and, secondly, in regard to *fidelity of response to modulation frequencies of the light flux.* These characteristics will be discussed in some detail.

When a vacuum tube is operated in series with a high resistance, say 10 megohms, and the applied potential is 90 volts, then the light flux normally used in sound projection will develop a current of the order of 0.5 microampere. This will create a potential drop across the resistance of 5 volts, leaving now 85 volts across the tube. But since the voltage is still quite ample to produce saturation, the current flow will not be affected at all. Hence, as the intensity of the light fluctuates, the tube current will follow linearly. In the gas tube, however, where we might expect, say, 2.5 microamperes at 90 volts, this value of current would create a potential drop of 25 volts at the resistance, leaving only 65 volts across the tube. Thus the tube would really not deliver the 2.5 microamperes but some determinate value appreciably less. It becomes clear that when the flux doubles, the current does not double. There is introduced a lack of linearity which causes distortion of intensity. This could be rather serious but for two redeeming features. One is that the actual total change of flux is small enough in practice that the distortion is minimized. Again, it so happens that without any resistance in series, the current really increases more rapidly than the flux owing to a higher ionization efficiency at higher levels of illumination. With a typical gas tube ,it is possible to obtain almost exactly linearity with about 1 megohm in series. Since this is the same value of resistance that is normally employed in commercial sound projectors, it is seen that this one potential disadvantage of the gas tube becomes of no practical consequence.

There yet remains a discussion of the ability of the tube to respond faithfully to the modulation or signal frequency referred to as its *dynamic response.* The photo-current in a vacuum tube is strictly an electronic phenomenon. As far as audio frequencies of light pulsations are concerned, a vacuum tube is instantaneous in its action. It responds just as well to signals of 8,000 cycles as to those of 10 cycles. So long as merely ordinary precautions are observed with respect to shunting capacitance in the circuit, a vacuum tube may be counted as absolutely flat in its dynamic response for all audio frequencies of light pulsation. In the gas tube, the participa-

(*Continued on Page* 29)

The Ribbon Microphone

By ROBERT J. MARCY

WHEN radio broadcast first made necessary its use, the microphone was nothing but a very sensitive telephone transmitter or single button microphone. So long as the device used to transmit sound waves into electrical energy was used for speech only, its very narrow frequency response was not a serious drawback. However as soon as broadcast studios attempted to transmit music, certain limitations to its use were immediately apparent. It was then necessary to develop a transmitting device which responded to a much wider band of frequencies.

The first attempt to overcome the shortcomings of the early microphone was the "teaming up" of two single button units on a common diaphragm. This was the familiar double button microphone. For some years this instrument underwent mechanical and electrical refinements without any marked basic change in design. It had, however, several pronounced drawbacks and limitations. Chief among them were those of carbon hiss, produced by the movement of the carbon granules and a very definite "cut-off" or frequency limitation above 3,000 cycles. The attenuation was due to the design of the microphone and the comparatively heavy weight of its diaphragm which required a proportionately strong sound wave to set it in motion, and which would not respond to the higher frequencies. This limit of the response range, was the reason for the lack of natural tone reproductoin which characterized early broadcasting and the first sound films.

The Condenser Microphone

Engineers working on the development of broadcasting equipment had been experimenting with various types of microphones, as had been technicians engaged in pure research in the field of sound. To the latter is due most of the credit for the development of the Condenser Microphone.

The Condenser Microphone was a marked improvement over previous instruments and was immediately adopted by broadcast and sound recording studios. However, it too was found to have imperfections.

The inherent factor of diaphragm inertia was still a decided limit to the transmission of lower frequencies by The Condenser Microphone, while its extended frequency range and design introduced two new drawbacks, diaphragm resonance, and cavity resonance.

Diaphragm resonance of no account in the operation of previous microphones, since their frequency range did not extend to the point at which the diaphragm resonated, now caused considerable distortion of higher frequencies. Cavity resonance, due to the enclosed chamber in which the diaphragm operated, also occurred within the audio range and further hindered faithful recording.

The Dynamic Microphone

Closely following the advent of the condenser microphone came the dynamic microphone. This instrument was far more sensitive than the condenser microphone, but had the disadvantage of picking up background noise and reverberation. This made its use in public address systems and sound recording equipment highly impracticable as only under the most perfect conditions, such as those of broadcast studios and acoustically treated theatres could this instrument be employed.

With sound recording engineers, laboratory technicians and those whose interest lay in the field of broadcasting working for a more perfect microphone, it was enevitable that one should appear which retained all the advantages of the previous instruments with as few of their limitations as possible.

The Ribbon Microphone

The Ribbon or Velocity Microphone, operating on an entirely different principle from those microphones which have preceded it, is the latest step in the development of this unit of sound transmission equipment.

The mechanical design of the ribbon microphone has virtually eliminated the chief drawback of other microphones, that of inertia. Instead of a diaphragm, the microphone employs a thin, corrugated metal ribbon. Suspended between the poles of an electromagnet. Sound waves reaching the ribbon vibrate it within the magnetic field set up by the electromagnet. The vibration of the ribbon within the magnetic field, sets up corresponding alterations across the primary of its connecting transformer. This output is amplified to transmission level by an amplfier using three vacuum tubes. Since this ribbon has very little mass, it requires almost no energy to set it in motion. For this reason, the faintest whisper will be faithfully transmitted without loss or distortion. The ribbon is corrugated to give it greater strength and rigidity and to place its point of resonance outside of the recording frequency range.

The pole pieces between which the ribbon is suspended also act as a baffle. In experiments carried on to determine the proper mechanical design of the pole pieces, it was found that their area had a very definite influence upon the directional frequency response. If the baffle they formed was too small, the microphone would lose its directional properties, while an increase beyond a certain point in the size of the baffle had no effect upon the frequency response.

Operation

Like the condenser microphone, the ribbon microphone was originally devised as a means of measuring sound. In fact, the two types of instrument may be conveniently compared to corresponding measuring instruments of electricity, the Voltmeter and Ammeter.

At a given point, the sound wave has two components: (1) pressure and (2) the velocity of the air particles at that point. If we compare sound pressure with voltage or electrical pressure, and sound velocity with amperage or rate of electrical flow, the pressure operated microphones — carbon, condenser and dynamic may be compared to the voltmeter, while the ribbon type, whose response is in accordance with the velocity of the wave may be compared to the ammeter. However, "Pressure Response" and "Velocity Response" are terms which need further elaboration if the difference in operation of the two types of instruments is to be clearly understood.

The diaphragm in a microphone like that of a telephone, has only one side exposed to the sound wave. Moreover, as in the telephone, the microphone diaphragm is fixed about its circumference. The ribbon, however, has two surfaces exposed and although it is fixed at both ends, the greater part of its edge is free. To respond to the wave the diaphragm must in reality be bulged by it and it is because of this that the factor of inertia limits reproduction of higher frequencies since the diaphragm cannot bulge and resume its original shape quickly enough.

In addition, the diaphragm being closed on one side forms an obstruction to the sound wave compared to which the ribbon is negligible. The diaphragm therefore requiring *push* to move it, may be said to operate in response to the *pressure* of the wave.

The response of the ribbon might be termed a flutter. The difference of the action of the sound wave on the diaphragm and its action on the ribbon will be brought out I think by recalling the familiar sight of a cork on a fishing line as it bobs on the water. The cork offers practically no resistance and responds to every ripple on the surface. But more important, since there is nothing behind it, the waves are not hindered in their flow so that as they approach and pass it,

(*Continued on Page* 31)

Types of Photo Electric Cells

By KASKEL KALLMAN

Regarded with wonder by the layman, to whom through popular science it has recently become known as "the electric eye," the photo-cell needs no introduction to the projectionist. However, there are several different types of photo-cell. Since most articles deal with a particular type, there seems room for one giving a brief classification of the different photo-cells at present in use, tracing their history and pointing out the characteristics of each.

The Photo-Voltaic Cell

There are three distinct divisions of photo-electric cells namely, the Photo-Voltaic, the Volume Photo-Electric, and the Surface Photo-Electric cells. Of the three, the surface photo-electric cell is the most widely used.

History records that in 1839 Becquerel discovered the photo-voltaic effect. This type of cell differs from the others in that it generates its own potential depending upon the amount of light falling on it. The effect was first noted in an early voltaic battery which changed its potential when it was standing in the sunlight.

Of this type of cell there are two subdivisions, the wet and the dry. One of the most common forms of the wet cell usually consists of two electrodes in an electrolyte, similar to a storage bettery. One electrode is lead and the other is copper with a layer of cuprous oxide deposited upon it. The solution is lead nitrate.

The dry cell has been made well known by the Weston Company and its Photronic Cell. No fluid is used, merely two films of metal superimposed upon each other. One dry type is the combination of films of platinum and iron and another of silver selenide and cuprous oxide. In each of these cells it must be understood that no external potential is applied across the two elements.

The Photo-Voltaic cell has recently come into use as a light-intensity meter for photographic work. When used in photo-metric work, the current output of the cell is fed directly into a sensitive ammeter which has been calibrated in foot-candles to determne the amount of illumination.

The Volume Photo-Electric Cell

The next type of cell that was discovered is known as the Volume Photo-Electric cell. It was in 1873 that Smith found the effect in selenium. This type of cell requires a potential applied across it. The selenium is of a high resistance when no light is present but becomes relatively low resistant when light impinges upon it. The light falling on the cell, theory has it, causes a re-arrangement of the atoms of selenium. This re-arrangement of the atoms actually changes the electrical resistance of the substance. With a constant potential across the selenium, a varying current is set up in the circuit due to light variations. This type of cell did not prove practical in the motion picture field as its response was not critical enough for high frequencies. Research laboratories are at present working to increase the possibilities of selenium by enclosing it in an evacuated tube. Other substances that produce similar effects are zincblende and sulphur.

The Surface Photo-Electric Cell

The third type of cell, the Surface Photo-Electric cell, is the most well known. It is to be found in all standard sound reproducing equipment. It is so-called because the electronic emission takes place from the surface of the light-sensitive substance, whereas in the selenium cell, the emission s from the body of the metal. The hitory of this type of cell is most interesting since the story of its discovery is typical of the spirit of research.

While Hertz was working with electro-magnetic waves in 1887 he noticed a peculiar effect from his apparatus. He was able to induce in a secondary circuit a spark from a primary circuits were not connected electrically. the first wireless set since the two circuits were not connected eletcrally. The primary circuit consisted of Leyden Jars, which stored static charges, a sort of antenna and a static machine to produce static electricity. The secondary circuit consisted likewise of an antenna and another set of Leyden Jars but no static machine. His object was to cause the spark in the primary circuit to induce another spark in the secondary circuit and rather to the surprise of the famous physicist, it did. On one occasion Hertz noticed that the length of the spark in the secondary circuit was diminished when the light from the spark of the primary circuit was blocked off. Upon investigatoin he found it was due to the light falling on the secondary spark gap.

This investigation was followed by a more intensive survey on the part of Hallwachs. He experimented with a special electroscope and a carbon arc. The electroscope consists usually of a knob of metal supported on a metal rod, insulated from its supports, which extends into a container and to the lower end of which is hinged two small pieces of gold foil. When a charge of static electricity is placed on the knob the gold leaves diverge outward from one another. If the charge is lessened the leaves come closer together and if the charge is completely removed the leaves fall together in a vertical position.

Hallwachs used a small zinc plate instead of the knob. If he put a positive charge on his electroscope the leaves would diverge. When the zinc plate was illuminated by the carbon arc there was no noticeable effect on the leaves. If, however, the electroscope had a negative charge upon it and the zinc plate again illuminated with carbon arc, the gold leaves would slowly converge. From these observations Hallwachs concluded that the light had the property of emitting negative electricity from a zinc plate. We now know that negative electricity is, in sum and substance, the flow of electrons. As the electrons shot off the plate the total negative charge was reduced. This reduction in charge caused the electroscope leaves to converge. These electrons could escape from the plate only when the conditions were right, that is, if a negative field existed around the plate the electrons could not escape. An application of this phenomenon is seen today in the radio tube. The heated filament ejects electrons only so long as the grid is positive or neutral.

Thus from these early investigations we come to our modern cells of cesium, potassium, sodium, and one or two other metals. It is interesting to note at this point that the cesium cell is more sensitive to the reds of the visible spectrum while the sodium and potassium cells are more sensitive to its blue parts.

Patents

A Complete service:
Inventions developed. Models and drawings. Also searches.
Patents obtained by registered Patent Attorney, former patent chief of large corporation, and a successful inventor himself. Rates low for highly skilled service.
Foreign patents obtained economically through associates abroad, visited during world tour.
Sales campaigns conducted, on commission, to market patents. Contracts drawn.
Also trade marks, designs, and copyrights.
Write for FREE ADVICE, or phone.

RAY BELMONT WHITMAN
277 PARK AVE., N. Y.
Phone: Wickersham 2 - 7600

Finishing the Picture

By W. C. HARCUS *

IT may never have occurred to those who have not been directly concerned with the production of motion pictures that a picture is far from complete when work is finished on the stages and the actors have been dismissed. As a matter of fact, in most cases the expenditure of time and money up to this point has simply resulted in the accumulation of several hundred thousand feet of picture and sound track film. Since the average length of feature pictures as shown in the theatres is but seven or eight thousand feet, it is apparent that the greater part of this tremendous mass of material can not be shown. The dramatic and artistic values of the completed production will depend to a very large extent upon the skill and intelligence used in selecting the material and upon its arrangement in a clear and logical order that will develop and hold the interest and attention of the audience before which it is to be presented. A very important contribution to the success of a picture is made by the group of men who are responsible for the editorial function.

In considering the technic that has been developed for editing film, it may be presumed that in the preparation of the original scenario or script the dialog and action were completely thought out in detail so that all the necessary material is at hand. In the economical production of sound pictures it is essential that each scene be weighted according to its proportional value to the production as a whole and its approximate footage estimated; also that each scene be considered from this standpoint as to the camera angles needed to portray best the proposed action. This amounts to cutting the picture tentatively in advance of shooting and may be called pre-editing. A unique example of skillful pre-editing is disclosed in the first scenes of a recent photoplay, *Dr. Jekyll and Mr. Hyde*, in which the audience views the acton through the eyes of Dr. Jekyll, and does not see him until he eventually approaches a mirror. In another instance, the ballroom scene in a recent Chevalier picture was photographed in synchronism with a previously recorded sound track of *One Hour With You*, which ran the full length of a sequence. It would have been impossible to obtain the smoothly flowing transitions from one group of players to another, or the high-quality song record, with a less skillfully planned and executed handling of the action. While it is possible to change some of the action in a picture while it is in production, this has to be done with discretion, as it may adversely affect portions of the work that have been completed as well as the previous plans for the work that has yet to be done. Certain types of comedy, such as the pictures in which the four Marx brothers appear, use a script as general outline; but most of the stage business and humorous lines and gags are more or less spontaneous, and are developed on the set.

Pre-editing was not so necessary for silent pictures, which consisted essentially of illustrated titles that could easily be rewritten and re-illustrated. In the case of sound pictures, recorded dialog can not be changed so readily, as audiences are accustomed to reading the lips of the actors, and immediately notice and criticize speech that is not in exact synchronism with the picture. An example of an attempt to change the dialog is seen in *Beloved Bachelor*, in which Paul Lukas is heard singing a lullaby to a child. Several attempts were made by Lukas to match words to a recent version of the picture by a dubbing process, but all were imperfect to an extent that was commented upon by many audiences. While words and phrases can be deleted by skillful cutting, a retake of picture and sound is generally required to obtain an acceptable result when it becomes necessary to change dialog delivered in close-up.

While the production company is working on the stages, the picture and sound negatives are processed each night, so that during the next day all prints desired by the director are available for review. The quality of picture and sound can be accurately judged as well as that of the direction and acting. From those that fulfill certain technical requirements, the director selects the best one of each group of takes of the same scene for use in the picture.

All motion picture production is handled on the double-film basis; that is, the picture is on one negative and the accompanying sound record is on another. With few exceptions, the daily prints are also made on separate films, creating a problem of obtaining and maintaining synchronism. Various methods of establishing synchronizing marks on the picture and the sound negatives which depend to some extent upon the camera motor system used are in use; but in their simplest positive form these methods consist in making punch marks on each at the beginning of every take. These marks appear on the daily prints together with identification slates or numbers that are used as cross-reference records by a script girl on the stage. The daily picture prints are classified according to the cameras used, all those made with a single or master camera being designated "*A* angles." If more than one camera is used simultaneously, the work of the second camera would be called "*B* angles"; a third, "*C* angles"; and so on. The "*A* angles" are assembled for the daily review in synchronism with the sound track; the *B*, *C*, and other angles are each assembled so that they will be in synchronism with the same sound track to avoid printing an additional duplicate sound record. In order later to permit removal of the original synchronizing marks during the cutting operations, serial numbers are applied to the edge of each foot of the daily prints, this being done in such a way that by matching the edge numbers all the angles of a given take will be placed in exact synchronism with the sound track.

The film editor and his assistant proceed to break down the assembled daily after selections have been made, and the rejected takes are stored for possible future reference. The selected takes are then assembled in continuity in so far as complete material is available at the time, to form each scene and sequence and eventually the finished picture. The mechanical technic of assembling the selected takes in continuity is fairly simple. The princal tools required are: a synchronous rewind consisting essentially of two or more sprockets mounted on the same shaft so that film being rewound from a number of reels will remain in synchronism at the sprockets at all times; a Moviola or small film-viewing machine so arranged that picture and sound films can be run through in contact to locate the exact point for cutting; a film-splicing machine; and a pair of scissors. In some studios most of the rough cutting is inspected on sound reproducing Moviolas, in others the inspection is handled in small review rooms equipped for projecting separate picture and sound film. As each sequence is cut together by the film editor in accordance with the script and the current ideas of the supervisor and director, it is reviewed again and again so as to "smooth out" the awkward spots, the takes and angles being changed as required to obtain the best result. Since this work is carried on as soon as possible after the material is shot, those portions that seem to warrant retakes or added scenes can often be made while the company is still on the same set.

Within a few days after the production unit has finished shooting, the editing of the sequences is completed, and it is then possible to complete the assembly of all the sequences into a "cutting print" (sometimes called a "working print"). The cutting print forms the first rough semblance of the finished picture, and is generally found to be from ten to fifteen thousand feet long. It becomes the task of the supervisor, director, and film

---

**By Permission of Society of Motion Picture Engineers.*

editor to refine and rearrange the elements of the picture into a smooth, coherent, well-balanced photoplay of normal length. Certain scenes and sequences are shortened or removed so as to quicken interest and maintain the tempo; others are lengthened so as to emphasize essential detail. It is usually at this stage that many of the incidental bits of action that were thought to add "atmosphere" to the production are eliminated, to the disappointment of many a Hollywood extra player. In a recent production, *Broken Lullaby*, for example, almost as many of the beautifully directed characterizations of the townspeople of the little German village were eliminated as were retained. Occasionally a production is temporarily stopped before completion in order to determine whether certain sequences in the script are really essential; such an instance occurred during the filming of *Shanghai Express*, when completion of a preliminary cutting print disclosed that a very thrilling (and costly) running battle between government troops and revolutionists on two moving railway trains was unnecessary. In other cases, particularly when transparency and trick photography are involved, the shooting is deferred until the first rough cut of the reels concerned is available, so that the photographic quality can be matched more precisely and so that the action in these more complicated processes can be compared with that already completed. Such was the case in *The Right to Love*, when all the action in which Miss Chatterton played two roles simultaneously was cut completely, prior to shooting the transparency work in which both characters were introduced into the one negative.

The time required to complete the cutting print varies considerably, depending upon the nature of the picture and the individuals doing the work, as well as upon the release date that has been scheduled. As outlined above, editing commences as soon as the picture begins on the stages, and occasionally the cutting print is ready for approval a week after the shooting is finished.

Methods of handling the subsequent work, after the cutting print is approved, are subject to variation, depending upon the practice that has been developed in each studio. One of the most successful procedures, technically, will be described. The approved cutting print is sent to the film laboratory and the negative is cut to match it as a sample. A double-film "feeler print" (or "second working print") is made from the cut negative, and is compared with the cutting print for accuracy and to ensure that words or syllables have not been clipped from the sound track. The feeler print is then reviewed by representatives of the studio technical departments, who consult with the supervisor and director as to proposed music, sound effects, titles, and so on, and who outline the work that remains to be done. Those sequences on which work is to be done are listed, and additional "dubbing prints" are made by the laboratory.

A sound-effects cutter now appears as an important member of the staff. From the accumulation of recorded music and sound-effects tracks in the film library, he obtains much of the additional material that is required to enhance the picture, as agreed upon. This he assembles in synchronized reels, or as loops in the case of continually recurring sounds, and turns them over, together with the dubbing prints, as "units" to the scoring and dubbing departments for action. Several of the studios have two or three million feet of library tracks available for this work.

The scoring and dubbing, as is well known, results in the combination of new music and sound effects with the originally recorded dialog, and is done by specialists who fulfill, as nearly as possible and consistent with the limitations of present equipment, the specifications of supervisor and director. This phase of the work develops unexpected production values in many instances, and warrants the closest attention and interest of all those concerned. In the dubbing of *Shanghai Express*, for example, nearly sixty thousand feet of sound track were re-recorded, to obtain precisely the desired balance of dialog and sound effects during the train journey. Special recordings were made of a heavy train running at the speeds shown in the picture to insure correct sound quality. Similarly, in *Sky Bride*, the extraordinary effective dubbing work was the result of paying infinite attention to detail and to the possibilities of sound. Recordings were made of all available types of aeroplanes in order to obtain exactly the quality of sound desired. If the aeroplane sequences were visualized as they would be without sound, the dramatic contribution of the sound effects to the picture would be appreciated.

As soon as the daily sample prints of the dubbed and scored work are received, selections of the best takes are made by representatives of the departments concerned and are cut into the feeler print for review by the supervisor and director. The feeler print is carefully arranged in reels not exceeding one thousand feet in length, the end of each reel being cut at a fade-out between scenes, or at some point where there is no significant sound, to facilitate change-overs from reel to reel in the theatre. It is then returned to the laboratory, and the negative is recut to include the new material with scoring and sound effects.

Up to this point all the cutting and editing has been done on double films, the picture being on one set of reels and the sound on another. It now becomes convenient to make the first composite or movietone print, and this is done for preview purposes, the print being called the "preview copy." The picture is then ready to show for the first time to the studio management generally and to the public. Arrangements are made to project it at some local theatre as a part of the regular show. The Hollywood preview is a unique institution, and a brief description may be of interest to those who have not had the opportunity to attend one.

A breathless hush with just a brief ripple of applause sweeps over the audience as a silent title flashes on the screen: "A Mammoth Preview—This film is still in process of editing. As you leave the theatre a postcard will be handed you. If you will mail it with your comments, it will be greatly appreciated by The Mammoth Film Corporation." Although this title is shown for but twenty seconds, it seems minutes. It fades and the well-known trade-mark appears, and the accompaniment of music or sound effects, followed by the title of the picture and the credit leader. There is a burst of applause and a general buzz of excited comment, which often culminates in a subdued cheer when some screen favorite who happens to be the vogue heads the cast. Another moment, and the opening title fades to the first scene of the picture; the audience settles itself and the preview is under way. The author has observed many strange and unexpected audience reactions at the two hundred previews he has witnessed, and can vouch for the fact that the picture seldom seems exactly the same as it does in the studo preview rooms where it is viewed and criticized by those who have "lived with it" for weeks. Different audiences generally receive the picture in about the same way, but some executives believe that a more reliable reaction can be obtained when the preview is advertised to attract people who enjoy the type of picture being shown. Most audiences make a desperate effort to avoid showing emotion and will titter and laugh at a tense scene rather than wipe away a tear. The studio representatives are from long experience quite sensitive to the real feelings of the preview audience, and can generally diagnose the faults and weak spots of the picture at this showing.

No one has learned the formula for making pictures that will appeal to and please every individual who may see them. While the script is always edited initially with known censorship requirements in mind, and the dailies are reviewed in many studios by a censor representative, nevertheless details that may be considered questionable creep into all pictures. Even though every effort is made to delete such items before release to the theatres, the non-uniform standards of the several censor boards in the various states of this country and abroad create a story and editing problem which to some extent is incapable of complete solution. Because of this situation, it is sometimes necessary to modify the prints shown in some lo-

(*Continued on Page* 27)

Magnetic Arc Control*

By R. HOWARD CRICKS

SOME time ago I described the results of some experiments I had been making in connection with magnetic control of high-intensity arcs. I have in the past few months been carrying out further experimental work in this direction, the results of which are very interesting.

For the benefit of those who are sufficiently interested in the subject to want to puzzle out the why and the wherefore of the functioning of the various devices described, may I recapitulate the theory which apparently governs the reaction of the high-intensity carbon flame to a magnetic field.

Although such text-books as mention the subject attribute the effects to the respective attraction and repulsion of the negative and positive ions constituting the flames, for the north pole, this attraction and repulsion is the least important of several phenomena.

Magnetic Field and Fluxes

The most important, and one which always provides the primary results, is the effect of a magnetic field (not, be it noted, of the magnetic poles—the distinction is sometimes important) upon the fluxes of the flames considered as conductors, the positive flame carrying the current upwards and the negative flame downwards, both, of course, carrying the current from the positive to the negatve carbon (more advanced theories on electrical transmission being for the moment forgotten).

The reverse fluxes produced by these functions of the flames interact with the lines of force proceeding from the magnetic poles, producing the known effects, and also incidentally tending to separate the two flames.

The Number of Turns

The experiments previously mentioned were carried out at the Chadwell Heath works of C. H. Champion and Co., Ltd. The laboratory staff there produced in subsequent experiments a type of magnet which has since become very popular—the single pole, situated at the left-hand or farther side of a mirror arc, and wound to produce a south pole. Their specification calls for a core of soft iron strip, ¾ inch by ⅛ inch, wound with 22 turns of asbestos-covered wire, and connected in series with the arc.

In my opinion, it is better practice to use a heavier core and to wind fewer turns; thus on the new Gaumont-Super arc I employed a ⅝ inch round iron core, bent and flattened at the top to a chisel edge, and wound with 4 turns only. This light winding provides ample control of the flame, the heavier core, of course, serving to intensify and direct the field with more certainty. Admittedly, however, it is rather beyond the scope of the average projectionist to turn out such a job.

Rectified Current

All these and previous experiments were of course, carried out with ordinary D.C. Some two or three years ago I installed in a London kinema a Crypto rectifier which was intended to run H.I. arcs. The output of a commutating rectifier is, of course, pulsating, and cannot be thoroughly smoothed owing to the risk of causing sparking at the commutator.

This occasion was, I believe, the first that this type of machine had been installed for running H.I., and rather to my surprise I found that the light did not appear to be anywhere near so intense as one would have expected for the amperage. Several other exhibitors have since found the same trouble with these exceedingly simple, compact and inexpensive machines.

The matter was all the more puzzling since it is an accepted fact—backed by N.P.L. certificates—that on low-intensity, rectified current definitely produces a brighter and whiter light than direct. I was therefore rather pleased to be commissioned by Lancashire Dynamo and Crypto, Ltd., to carry out experiments with a view to improving this position.

The first thing was to formulate some theory to account for the difference. I decided that it must be due to the difference in specific heat between the crater which is the source of light in L.I. carbons and the ball of incandescent gas which provides the H.I. heat, the latter consequently cooling appreciably during the zero point of current flow.

Selecting the Type of Control

The only cure for this was apparently to devise some form of magnetic control which would not only concentrate the flame during the period of maximum current flow, but would also continue to stabilise and compress it at zero current flow; for with a flame, as with any other gaseous body, compression causes heat.

My first thought was some form of permanent magnet. This would have had the disadvantages of gradually

Wise Projectionists

Change to

NORIS CARBONS

because

1. NORIS CARBONS produce unvarying brilliancy, improving projection.
2. NORIS CARBONS operate on lower amperage.
3. NORIS CARBONS burn longer effecting greater economy.
4. NORIS CARBONS too, are lower in price.

"The Standard of Quality for over 75 years."

"NORIS-HS"
"NORIS-SCH"
"NORIS CHROMO HI-LO AND HI-INTENSITY"
in all Standard Sizes

Inquiries Invited

NORIS CARBON COMPANY, Inc.

NEW YORK, N. Y. Mohawk Building 160 FIFTH AVENUE

Sole Distributor for C. Conradty, Nuernberg, Germany

**Reprinted, Kimeatograph Weekly.*

losing its power, and of being entirely independent of the amount of current flowing, neither of which was desirable. A soft iron magnet would, of course, cause the field to pulsate in sympathy with the current flow, which was just what I wished to avoid. So some sort of compromise was needed, which I eventually found by using case-hardened steel.

An Arc Voltage Discovery

The first arc I worked on was a H.I. mirror—Gaumont Eclipse, to be exact. Normally I found that there was a drop of light of about 25 per cent on rectified current as compared with direct. Finding a single-pole magnet not very satisfactory I reverted to a semicircular magnet, made of case-hardened steel, and 10 inches in diameter, to clear the light beam.

This was wound to give the conventional polarity—N to right, S to left—which had the effect of depressing the flame, however, contrary to my previously held views—which are unundoubtedly applicable to D.C.—that a high arc voltage does not necessarily mean an increased light on rectified current. Although this magnet reduced light fluctuations, it did not appreciably increase the light.

I tried reversing polarity, which had the effect of making the flame stand up sharply, although still quite small. The arc volts actually dropped, to about 25 or less—but I attained the desired increase in light. As a result of further tests I was able to state that not only was rectified current the equal of direct, on the basis of candlepower per ampere, but actually that rectified current with this magnet gave more light than D.C. without, while light fluctuation and colouration were much reduced.

The next job I tackled was the Hall and Connolly arc. Here I found the difference between direct and rectified current to be about 33 per cent. Owing to the angle of the carbons—normally more efficient than parallel carbons—any type of wound magnet appeared far too fierce.

A Searchlight Model

I therefore reverted to a magnet of a type used in searchlight work — merely a metal plate wtih a centre hole to accommodate the positive carbon, and a vertical slit running from this hole, forming substantially a horseshoe magnet with the poles pointing upwards and with a very narrow gap, excited merely by the flux of the positive carbon.

This was fixed in place of the positive heat shield on the arc. A little experimenting was needed to obtain the best dimensions, but eventually a suitable magnet plate, ½ inch thick, and again I was able to claim a slightly greater efficiency for rectified than direct current, the light being about 5 per cent greater. The only difference in control is that the arc volts must be kept low—about 50 to 52—and the negative carbon high.

Finishing the Picture

(*Continued from Page* 25)

calities to a form that hardly resembles the studio version.

Finally the studio management approves the picture for release, although it may be said that it is seldom that any one concerned is entirely satisfied with any picture. However, since it is necessary to work within budgets and to meet release dates, the time available for making refinements eventually ends. The negative is subjected to a final cutting, and a movietone "answer print" is made by the laboratory. The answer print is made with great care to secure the optimum photographic results, reference being made sensitometric and printer light data derived from the laboratory work done on the previous daily, feeler, and preview prints. The answer print is reviewed by technicians who make appropriate modifications of printer light settings, etc., in advance of a final sample print called the "studio copy." The studio copy represents the standard to which all subsequent release prints are made to conform, in so far as this can be controlled directly by the studio and its local laboratory technicians.

The evening of the premiere showing comes with its bright lights and brilliant assemblage. There is applause for the stars, the producer, the director, who have used the film medium as a tool to create a new entertainment. The more perfect the illusion of reality, the faithfulness of tone and color values reproduced, the smoothness of continuity and movement, the less conspicuous become the contributions of the many unknown technicians whose untiring efforts have effected this pleasing result.

Lester Cowan, executive secretary of the Academy of Motion Picture Arts and Sciences, has left Los Angeles for a three weeks' eastern trip in connection with the program of the film body's technical research council.

Cowan will vist Chicago, Rochester, New York and Washngton, to discuss coordination of the Academys' technical activities with equipment and supply manufacturers and theater executives.

Hoffmann-Soons

PERFECTION
Reg. U. S. Pat. Office

It is no exaggeration to say that our rheostat is internationally famous.

Four out of every five theatres in this country use **Hoffman-Soons Rheostats exclusively.**

A first class product, backed by reputation and guarantee. It always leads the field.

Now equipped with solderless, adjustable lugs to take wire sizes from No. 4 to No. 4/0 without any additional cost.

The Only Union Made Rheostat

HOFFMANN-SOONS
Electrical and Engineering Corporation
387 First Avenue New York City
Manufacturing Division
Contracting Electrical Engineers
Moving Picture Electrical Speecialists

RHEOSTATS

Power For Field Circuits of Loud Speakers

By W. G. BOYDEN*

IN all lines of human endeavor there is a constant urge towards simplification and improvement. This may be brought about in two ways: elimination of non-essentials as in the reduction in the number of parts or the refinement of existing methods or material. The effect of both of these ideas can be noted in the advances and improvements made in the reproducing equipment used in theatres today when compared with the equipment originally nstalled.

As one reviews the progress of talking pictures, the original equipment often seems outlandish in the light of present day practice. However, it must be remembered that the talkies were not an outgrowth of the moving picture theatre but were developed by communication engineers generally unacquainted with the practices of moving picture projection in theatres. From this viewpoint one appreciates the magnitude of the task of developing, manufacturing and installing in a very limited time the necessary equipment for the reproduction of sound in thousands of theatres in all parts of the world.

Upkeep of Batteries

One item in the original equipment that was the source of much care and trouble was the batteries. Every theatre originally equipped with sound in the early days had a room full of batteries. These batteries were used as a source of "pure" direct current, free from ripples and commutator hum which might cause background noise in the reproducing system, to supply the necessary direct current to the excitation lamps, the filament current for amplifiers, indicating lamps and to supply magnetizing current to the field coils of the loud speakers. It had been the practice to use battereis to supply current to the amplifiers of public address systems, so that it was natural to continue this practice when the public address systems were adapted to theatre use. These batteries had to be charged, watered, and cleaned at regular intervals and in order to give satisfactory service could not be neglected. In addition to requiring constant attention, the lfe of the batteries was a variable factor depending on the use and care given in each case. The life was relatively short as generally replacement had to be made about every two years. In spite of the original cost, short life and maintenance problems, the batteries have served the purposes as originally intended. However, the fact that many theatres are using batteries today is not an indication that the cost of batteries is a small item in many operating budgets.

Use of Main Current Supply

It was the consideration of these facts that led to the development of a horn field control cabinet in order to eliminate the "H" batteries, which supply magnetizing current to the fields of the loud speakers. This elimination is possible as a result of the general use of direct current arcs in the projection lamps. In order to supply theatre circuits some source of direct current is always available either from a motor generator set or from the supply circuits of the power company.

The use of direct current from the circuit supplying the arc current provides a neat solution to the problem of current supply for the fields of the horns. It is only necessary to insert sufficient resistance in the circuit to limit the current to the required value. Due to the inductive effect of the field coils of the horns the current is sufficiently filtered to prevent any background noise due to commutator ripple or variations in the supply voltage. An ammeter is included in the equipment to enable the projectionist to check the current value at any time. A rheostat, conviently operated by a handwheel, is provided to compensate for changes in the supply voltage as indicated by the ammeter in the field circuit.

The cabinet is arranged for wall mounting at a convenient location in the projection room. It includes all the necessary components required for operation including a pilot light, current regulating rheostat, ammeter, main line switch and monitor cut-out switch. These items are mounted on the cover of the cabinet. In addition to the parts previously mentioned, the interior view shows the fuse block and the terminal block. The necessary wires for making connections are brought in through knockout holes in the bottom or sides of the box.

Installation

When the horn field control box is installed, the handwheel on the rheostat is turned clockwise to the limit of its travel. The contact arm on the second rheostat, which is independent from the contact arm on the rheostat controlled by the handwheel, is adjustable by hand when the cover is open. This contact arm is turned counter-clockwise until it strikes the stop. These adjustments insure that the maximum resistance is "in" before the unit is connected to the supply mains. The main switch is turned to the open position. The wires from the direct current source are connected to the terminals on the fuse block. When the connection is made the polarity of the supply circuit should be checked to insure proper indication on the ammeter. The fields of the horns on the stage should be connected in series and the leads connected to the terminal block. The field of the monitor horn should be separately connected to the terminal block. The monitor horn is connected as an individual circuit to permit the use of a short circuiting switch to cut it off when the projectionist is not using the monitor to check quality of the sound.

Operation

After making the connections, the direct current circuit is energized. When the main switch is turned to "on" current will flow through the circuit consistnig of the fields of the loudspeakers on the stage and the monitor horn. It is necessary to adjust the field current to the correct value by means of the rheostats. The handwheel of the rheostat on the front of the cover is turned to a position midway between the two limiting positions. Then the contact arm on the second rheostat is turned clockwise until the ammeter indicates the correct value of current. The adjustment is now complete and the cover is closed. Any further changes in current due to variation in supply voltage can be compensated for by means of the rheostat operated by the handwheel on the cover. The pilot lamp serves as an indicator by showing when the field circuit is energized.

The advantage of the horn field control cabinet is in the elimination of the "H" batteries, which require constant attention, and the insurance of a dependable source of suitable exciting current for the fields of the horns. By using the same source as the projection arcs there is little question regarding the dependability of the power supply. After the cabinet is installed it requires no further attention and replacements are limited to a very small item—the pilot light. These cabinets have proved economical and satisfactory in every application.

---

*Engineering Department, Ward Leonard Electric Company.

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO., 844 So. Wabash, Chicago.

Within the Photo Tube

(*Continued from Page* 21)

tion of positive ions in the current introduces a virtual inductance in the circuit so that the alternating component of the current is definitely smaller for rapid fluctuations. A frequency distortion is introduced which is serious enough to require artificial compensation.

The virtual inductance of a gas tube is explained in the following manner. With a given steady light flux in the tube, there is an equilibrium density of electrons and positive ions distributed in the inter-electrode space. If the light is suddenly extinguished, most of the electrons continue their journey to the anode, producing their usual quota of ions. This happens in a truly negligible interval of time. Of the ions present, some immediately recombine with a few of the slower electrons, others diffuse to the walls of the tube, while the remaining fraction arrive at the cathode. All three of these processes would be completed by the end of a ten-thousandth of a second and would thus not account for any appreciable prolonging of current. It could still be said that the current ceased instantly upon the extinction of the light.

The percentage of positive ions, however, which are dashed against the cathode give rise to a number of secondary electrons in the manner already described. Even though the light is off, there is this fresh group of electrons starting toward the anode just as though the light were still present, although diminished in intensity. This cycle of events continues until finally no more ions are left to reach the cathode and the current falls to zero. This prolongation of current may amount to several thousandths of a second. Similarly, it also requires several thousandths of a second for the current to reach its equilibrium value when the light is suddenly thrown into the tube. It follows also that if the light flux fluctuates about a mean value more rapidly than the current can come to its successive equilibrium values, the alternating component of the current is not going to be as large as if the flux were changing at a slower rate. It is actually observed by measurement that at 1000 cycles of light pulsation the alternating current component is only 80 to 90 per cent of the value at 100 cycles, while at 5000 cycles the response may be only 60 per cent. The actual decline of the dynamic response depends in a measure on the particular tube used and the parameters of the circuit. It has been found empirically that tubes filled with argon are better dynamically than those employing either neon or helium. This is another reason for the choice of argon. Also, the lower the gas amplification, the flatter the dynamic response. Thus a tube with high cathode sensitivity and lower gas ratio is preferable. Yet with the best obtainable cells, the dynamic response declines with frequency. The fact still remains that at the highest audio frequencies recorded on sound film, the dynamic response of the gas tube is higher than that of the vacuum tube. Hence it is quite feasible to sacrifice the excess output at lower frequencies by peaking the amplifier for highs to obtain a flat over-all fidelity. This peaking should be done anyhow to correct for weakness of high frequency signals in film recording, and the peaking for the gas tube can be included in the design of the amplifier.

It is generally conceded that the vacuum tube is more constant and more stable than the gas tube, and should therefore be preferred in applications of a semi-calibrated nature. But in sound projection where height of signal strength above noise level is the most important feature, it may be concluded from the preceding discussion that the gas tube yields an output several times as great as that of the vacuum tube without any ultimate sacrifice of quality.

SUN-ARC CARBONS

FOR

PERFECT PROJECTION

"Best by Test"

BIG SAVING—COMPLETE SATISFACTION

BETTER LIGHT—SLOWER BURNING

CARBON SAVERS (Patent pending) free of charge. 2 Savers for each Theatre. Burn Hilow and High Intensity down to 2 inches and less.

CARBONS FURNISHED READY FOR USE WITH THE SAVER. No inconvenience whatsoever for the operator.

HIGH INTENSITY CARBONS 13.6 are furnished 22 inches long.

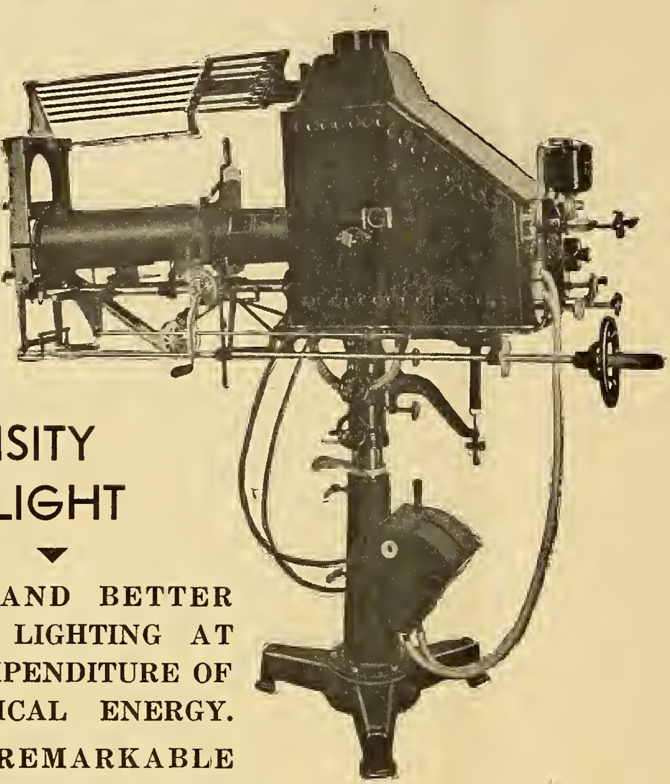
Hi-Low Carbons (for 60-85 amps.) are precratered.

SAMPLES ON REQUEST

Sun-Arc Carbons are sold with Unconditional money-back guarantee

CARBON PRODUCTS, Inc.

324 WEST 42nd STREET NEW YORK CITY



HIGH
INTENSITY
SPOTLIGHT

▼

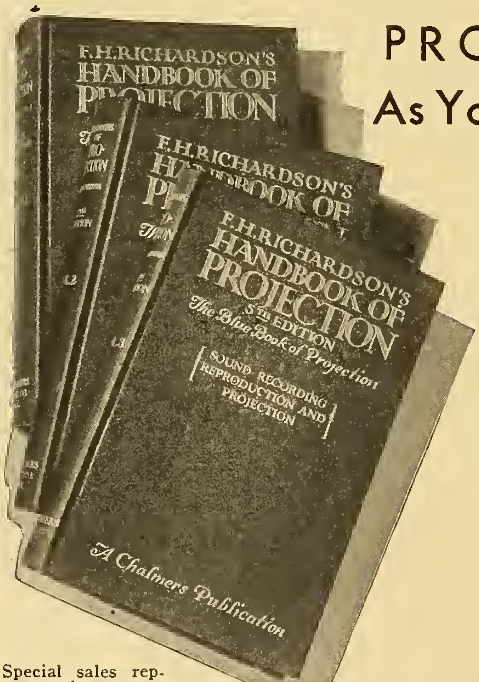
MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

▼

HALL & CONNOLLY, INC.
24 Van Dam Street New York, N. Y.

H&C INC.


F. H. RICHARDSON'S HANDBOOK OF PROJECTION
5TH EDITION
The Blue Book of Projection
SOUND RECORDING REPRODUCTION AND PROJECTION
A Chalmers Publication

PROJECTION
As You Must Know It

This 5th edition HANDBOOK OF PROJECTION by F. H. Richardson is known the country over. It has been the means of making thousands of projectionists masters of their profession. Remember, Richardson gave the "operators" of 1910 the first projection manual ever written.

Now 3 Volumes

Over 1,400 pages of the most vital kind of information. More than 400 illustrations. Each volume carries the special Richardson question and answer index—the greatest feature any projectionist could wish to have.

If your future is linked with projection make it brighter and securer by owning and studying this finest of projection libraries.

The complete set of three volumes mailed to your door upon receipt of check or money order for $10.25.

Special sales representatives appointed by the Chalmers Publishing Company, publishers of the Handbook on Projection. - - - -

MANCALL PUBLISHING CORP.
7 West 44th Street New York City

The Meaning of 'Potential'

If two electrically charged bodies are connected by a wire, a charge of electricity will be found to have passed from one to the other of the bodies. The question is raised as to the reason for this flow and as to its direction. An illustration of what happens in this case is that afforded by considering a similar experiment with water instead of electricity.

Suppose that we have two storage tanks connected by a pipe in which is a closed valve. Let us assume that the quantity of water contained in one tank is considerably greater than that in the other, but that the level of water in the tank holding less is the higher. When the valve is opened, the water flows from one tank to the other, but this flow is not from the tank having the *greater quantity* of water but from the smaller tank in which the water is at a *higher level.*

The same principle may be demonstrated by placing a penny heated to red heat on a block of copper which is at room temperature. The block of copper, by virtue of its greater size contains actually more heat in units of quantity (calories) than does the penny, but notwithstanding this fact, the heat will flow from the penny to the block of copper.

The flow of electricity from one body to another, due to a difference of potential, may regarded as having the same relation to quantity of electricity as does pressure to quantity of water or temperature to quantity of heat. As the flow of water continues until the contents of the two tanks are of the same level and the flow of heat continues until the two pieces of copper are of equal temperature, so will the flow of electricity continue until the two charged bodies are of one potential.

However, if in the first illustration, the water is continually poured into the higher tank and drawn off from the lower one, a constant flow of water will take place through the pipe connecting them. Similarly, if the ends of an electrical conductor are connected to a source of electrical energy, such as a battery or generator, a difference of potention will exist between the two ends and a continuous current will flow through the wire.

Measurement of level is made with reference to the level of the sea, while the melting point of ice has been found convenient as that from which to measure temperature. Differences of electrical potential are referred to the potential of the earth. The earth, for most practical purposes, is of the same potential throughout. The potential of a positively charged body is above that of the earth, while that of a body charged with negative electricity is below the earth's potential.

THE RIBBON MICROPHONE

(*Continued from Page* 22)

the cork may be said to register the *movement* of the wave rather than its pressure.

However, velocity itself is no more capable of causing motion than is the square root of minus one. It takes pressure to move the ribbon also. But as has been illustrated, since the latter by virtue of its minimum mass, freedom and open position offers no hindrance to the movement of the wave, the pressure in this case may be regarded as a continuous flow instead of a series of pushes. It may therefore be said that the response of the ribbon is in accordance with the velocity of the wave.

The operation of the ribbon microphone makes possible another advantage in its use not possessed by any of the diaphragm type namely, directional response. The diaphragm microphone is non-directional in its response, that is, responding to only the pressure component of the sound wave, it will register sound wtihin its receptve radius regardless of what direction it is placed with reference to the source.

With the condenser microphone it was attempted to make the instrument more selective by employing a parabolic reflector similar to that used for automobile headlights and other sources of illumination. This experiment did not prove very successful, but mention of it perhaps serves to illustrate the meaning of the word directional as used in this discussion.

The ribbon microphone, since it registers velocity rather than pressure, is directional. When it is placed so that the *plane* or *surface* of its ribbon is facing the source of sound, its response is maximum. Its response, when it is turned so that the *edge* of the ribbon faces the source is zero.

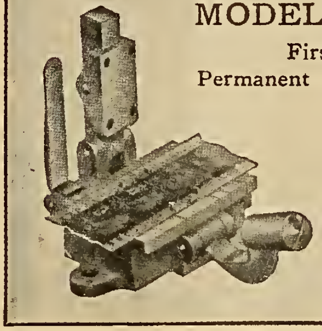
This feature is of particular advantage in the filming of a picture where, heretofore, elaborate precautions have been necessary to prevent the recording of extraneous noise. The use of the ribbon microphone does away with the necessity for camera blimps and other impractical means of preventing the pick-up of camera clicks, light hiss, etc., which accompany the operation of the photographic equipment.

Reverberation and Responsive Range

The ribbon microphone has also greatly overcome the factor of unwanted sound in the form of reverberation. Reverberation in a room being greater away from the source of sound than near it, has previously limited the placing of the microphone to some point within the scene. This has often made it necessary to restrict the dramatic action in order to avoid including the "mike."

Since reverberation is, in effect, the same at any point a given distance from the source of sound, it is not possible to totally eliminate it even with the use the ribbon microphone. It has been proved mathematically however, that where the dynamic microphone picks up all of the unwanted sound the ribbon type records only one-third. In actual use it has been found that the responsive radius of the ribbon instrument is nearly seventy-five per cent greater than that of the dynamic microphone. In other words the ribbon microphone may be placed that much farther from the source of sound without picking up any of the reverberation in the studio.

Universal Film Splicing Machine



MODEL NO. 3 Pat. March 22:22

First-Class Results on New or Old Film

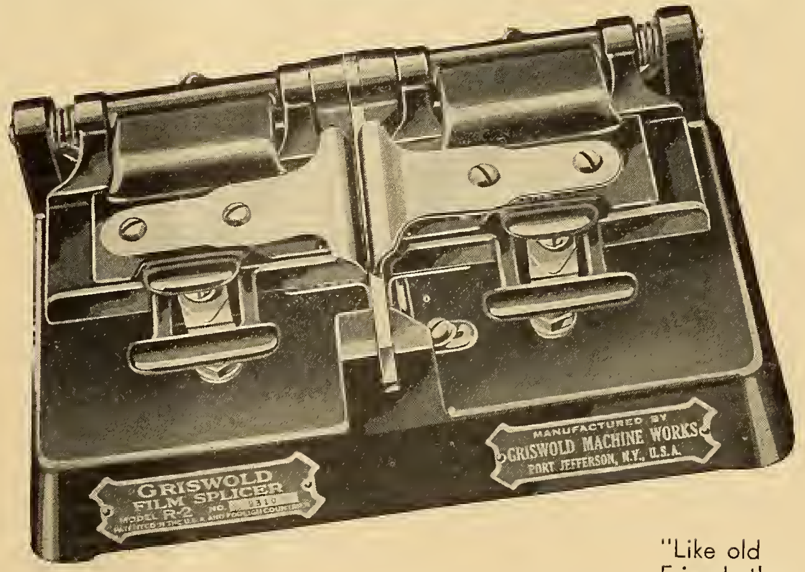
Permanent Gauge No Adjusting

FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS

Price $6.00

GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.

For sale by all Supply Dealers


GRISWOLD FILM SPLICER MODEL R-2
MANUFACTURED BY GRISWOLD MACHINE WORKS PORT JEFFERSON, N.Y., U.S.A.

"Like old Friends they wear Well."

GRISWOLD Splicers never break down. Of simple design and sturdy construction; they do a direct and effective job.

That's why only GRISWOLDS are found in the best projection rooms.

GRISWOLD MACHINE WORKS

Port Jefferson, Long Island New York

The Multicellular Sound Absorber

By ERNEST V. AMY*

ABSORPTION of sound energy in an enclosed space is a problem, the solution of which, today, has numerous commercial applications. It is at present being studied by many acoustical engineers.

Among the various means of absorbing sound waves, multicellular structures have long been recognized as the most effective. We have, for instance, the remark of Lord Rayleigh, once the greatest authority on the subject besides Helmholtz, that a hay stack, or some similar structure made of large quantities of tubes or cells, loosely packed and of small cross-sectional dimensions, might offer the best solution to the problem.

It is the purpose of this article to examine the principles governing the operation of multicellular absorbers; pointing out how the energy is dissipated, and how such structures may be designed most efficiently.

Principles of Sound Absorption

Most of the energy contained in the sound waves reaching the face of the sound absorber should be converted into heat so that very little of it is returned in the form of reflected waves into the room. The conversion takes place in the following ways:

1. By molecular friction in the air itself due to its viscosity.
2. By internal molecular friction in the solid walls of the structure.
3. By the heat energy generated during compressions of the air, part of which is not completely restored during the subsequent rarefactions which constitute the sound wave.
4. By the formation of eddy currents near the openings of the tubes.

Construction of Block

It is preferable to employ for the absorber a material which is workable or deformable under the air pressures developed within the pipes and which absorbs in internal friction a considerable portion of the energy required to deform it. In cases where fireproof construction of the Acoustic Block is not required, the unit may be completely assembled from corrugated cardboard in place of asbestos board.

The acoustic block here described is constructed of corrugated asbestos board so cut and assembled that it forms a composite unit consisting of a very large number of small tubes open at one end and closed at the other. The sound entering the open end of the absorber must pass through each tube down to its closed end and back to the open end again in order to be reflected. Since the inner surface of these tubes is rough, there is great resistance offered to the flow of the sound waves and hence, the latter are highly attenuated or dissipated.

The form and nature of the energy absorbing structure or material should be, preferably, aperiodic in its action, or if it has a natural period of its own, its natural period should be far removed from the natural period of the air columns which serve it. Since the sound energy is absorbed into the mass of the structure in which the pipes or air columns are formed, as great a mass should be employed as is possible in a given space. The pipes must be located close together so that as far as possible every part of the mass feels the effects of the air waves within the pipes, responds thereto, and accordingly absorbs energy to as great a degree as possible. Hence, the pipes must be numerous with relatively thin walls between the air columns.

Lengths of Pipes

The shape of the pipes or cells in cross section is relatively immaterial; that is to say, it is unimportant whether each pipe is of some regular shape in cross section, or whether it has an irregular cross section except as the shape of the cells may restrict the flexing or other working of the pipe walls or unduly reduce the friction to which the air flow within the pipes is subjected.

The proper lengths for the pipes may be determined experimentally by known acoustic laws for resonating pipes as before indicated. A simple formula is: L (length of a pipe in inches) is equal to 3350 divided by n (frequency of the sound, or the lowest frequency of a complex sound or a number of sounds, particularly intended to be absorbed, expressed in cycles per second.) This formula is readily derived from the known acoustic laws, and the factor 3350 is based on the pressure of the air at sea level, and may be modified for greater altitudes as will be understood. By way of example: For pipes closed at one end, the length of each pipe may be equal to one-fourth the wave length of the sound it is intended to particularly absorb or surpress, or an uneven multiple thereof; thus a closed pipe to absorb or surpress a sound pitched two octaves above middle C, may be about three and one-quarter inches long, or an uneven multiple thereof.

Experience has shown that for fullest absorption of frequencies of 256 cycles or lower, the tubes should be at least 10 inches long. This minimum length was, at first, a serious limit to the use of the absorber block since a block of such thickness was seldom practical. Experimental laboratory tests have since proved that the absorption depends directly on the roughness of the walls, size of the opening of the tubes or cells, and their effective lengths, no difference being observed for a given length whether the tube is straight or bent in any direction. It has therefore been possible to maintain the effective length for low frequencies by simply bending the tubes at right angles.

Types of Block

To absorb sound of more than one frequency, this sound absorber can be employed in any one of a number of ways. Pipes of various lengths may be used, respectively, of such lengths as to tend to resonate at the various frequencies to be absorbed, and respectively, of suitable diameter for their frequencies; or the pipes may be of equal lengths and diameters, each being long enough to resonate at the lowest frequency to be absorbed and of sufficiently small diameter to act efficiently on the highest frequencies to be absorbed. Again these two forms may be employed cojointly; or pipes of one length may be used jointly with pipes of other lengths.

In laying the absorber blocks the containers of the tubes may furnish the structural support. It is essential, of course, that each block be so placed that its open side—that is, the side containing the open ends of the pipes—is exposed to the sound within the room or theatre.

Efficiency of Absorption Block

The efficiency of the block is shown by the following figures. Sixty-four feet of the material was tested in blocks measuring 1 ft. x 2 ft. x 3⅜ in. thick.

Frequency in Cycles	*Percentage Absorption*
128	26
256	53
512	93
1024	74
2048	63
4096	78

The sound aboorption coeffcients given above were obtained by the Johns-Manville Company. Standard reverberation chamber methods with a warble tone source were employed.

Projector Distribution Agreement Formed

An agreement has been signed recently in Leipzig between the Philips Concern and the German Nitzsche A. G., according to which the former is to handle the export and foreign sales of a new cinema projector "Matador" turned out by the Nitzche A. G. in nearly all countries of the world.

---

* *Amy, Aceves & King, Inc., Acoustical Engineers.*

THIS
BOOK
IS

A CHALLENGE TO EVERY PROJECTIONIST IN AMERICA

More Miehling books have been sold to projectionists than any other. . . . There have been others since Miehling's book was brought out . . . and all at a higher price . . . but Miehling's still remains as the only book written by a projectionist for projectionists. . . . That is why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of ALL sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

NOW ONLY

$2

SOUND
PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.

●

519 pages . . . .
Completely indexed
Fully illustrated.

Do Not Delay! Fill in this coupon and forward to us at once with your remittance. Do it now!

MOTION PICTURE PROJECTIONIST
7 W. 44th Street, New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $2.00.

Name..

Address...

City and State..

Position..

Theatre...

NATIONAL HIGH INTENSITY PROJECTOR CARBONS . . . WIN COMPETITIVE TESTS

COMPETITIVE tests of three makes of high intensity projector carbons, recently conducted by one of the largest theatre circuits in the presence of representatives of the carbon and lamp manufacturers, conclusively demonstrated the superiority of National High Intensity Projector Carbons.

Tests were made with both condenser and reflector type lamps using 13.6 mm carbons in the former and 9 mm in the later.

Steadier light, more even screen illumination, greater volume of light and more light per dollar of current were obtained from National Projector Carbons.

Meet the keen competition of today by using National High Intensity Projector Carbons. They insure maximum quality of projection—the steady, snow white light which pleases your patrons.

NATIONAL CARBON COMPANY, INC.

Carbon Sales Division . Cleveland, Ohio

Unit of Union Carbide UCC and Carbon Corporation

Branch Sales Offices:

New York Pittsburgh Chicago San Francisco

NATIONAL
PROJECTOR CARBONS

Every Projectionist should have a copy of the recently published handbook on National Projector Carbons. If you have not received your copy, fill out and mail this coupon.

NATIONAL CARBON COMPANY, INC. MPP12
Post Office Box 400
Cleveland, Ohio

Gentlemen: Please send me complimentary copy of the New Handbook on National Projector Carbons.

Name______________________________

Title_______________Theatre_______________

Mail to______________________________Street

City____________________State__________

MOTION PICTURE PROJECTIONIST

THE FALL OF THE TITAN

THE Motion Picture industry is going through another period of reorganization, partially brought on by the condition of the times and partially by its extreme youth. As it becomes wiser it will be organized, and operated more like a legitimate and responsible business than a "game" and then we shall see less exhibitionism and more attention to business.

The day of the titan or magnate seems to be passing with acceleration. He is literally being kicked down the stairs. In his place is coming a type of man who may not know very much about the making of pictures but who knows how to manage a large corporation and operate it economically. And he is smart enough to gather around him the wisest men who know how to do the right things. Now he may be making many mistakes but in the end it will work out for the benefit of the business.

When all is said and done the record of the titan in films is not so impressive. Looking back we find that with the exception of a few really meritorious and profitable pictures the run of films were quite ordinary and reveal the application of no unusual talent. In the field of exhibition the titan succumbed to vainglory and built, bought or pirated picture house after picture house which in the end rather pitifully revealed his own lack of vision and business acumen. For now these huge circuits are breaking up.

The Titan in the picture business is an exhibitionist. Surrounding himself with people who flatter him and cater to his whims he must see his every act, gesture and word exploited and broadcast. His name must appear on every billboard, every credit sheet, must be flung abroad in electric lights and must appear in every line of publicity and advertising copy. He moves in a world of ballyhoo and wind. Is there any wonder that each one of them in time, has been caught off his guard and become a prey to cooler, calculating minds and was eventually forced out of his own business.

That has happened to William Fox and is happening to others today. The only shining light, the only one who kept his head, operated like a business man, yet lacked none of the qualities of great showmanship was Marcus Loew. Today the Loew fortune is intact and the business he built is the most substantial and the most prosperous. So far as the record goes no frenzied financier of Wall Street ever got a grapple-hold on the Loew properties.

One by one the pioneers, the titans are passing. A tradition is passing. With it is going the color and the romance that is associated with these men. But they are giving way to stabilization and better management and for the sake of the thousands of men and women that are dependent on the motion picture business for a livelihood this is a better; a turn for the better.

SIXTH YEAR
of
PUBLICATION

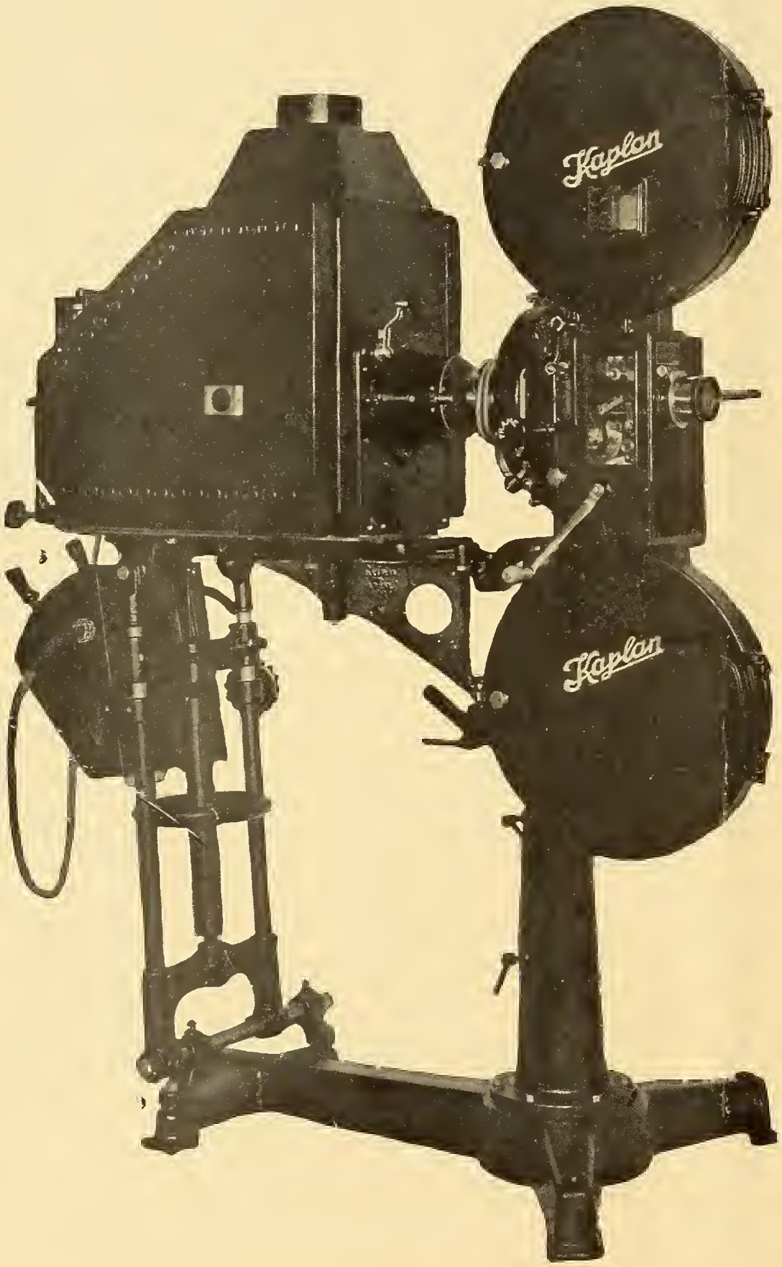
Published by the MANCALL PUBLISHING CORP., Boone Mancall, President.
Editorial and Advertising Offices, 381 Fourth Avenue, New York City
Entered at New York Post Office as second class matter, October 25, 1927.

Vol. 7 - - - - - No. 1
JANUARY, 1933
25c. per copy -:- $2.00 per year

ELECTRICAL MEASURING INSTRUMENTS
IN THIS ISSUE

Kaplan

PROJECTORS



Widely used in this country—known internationally, the Kaplan Projector is universally recognized as a product of the first rank it has earned its reputation because it is designed and built on the best engineering principles.

SAM KAPLAN MANUFACTURING and SUPPLY COMPANY, Inc.

729 SEVENTH AVENUE
NEW YORK CITY

MOTION PICTURE PROJECTIONIST

January, 1933 Vol. 6, No. 3.

EDITORIAL BOARD
CECIL B. FOWLER
ROBERT J. MARCY
KASKELL KALLMAN

Published monthly by Mancall Publishing Corp., 381 Fourth Avenue, New York City. Subscription rates in U. S. and Canada: twenty-five cents per copy; two dollars per year; three dollars for two years. Add fifty cents for Canadian, one dollar for foreign postage. Changes of address should be submitted three weeks in advance of publication date to insure receipt of current issue.

Entered as second class matter October 25, 1927, at Post Office, New York, N. Y., under the act of March 3, 1879.

Canadian Representative
H. N. Elliott, 203 Vaughan Road
Toronto, Canada.

Australian Representative
McGill's Agency
179 and 218 Elizabeth Street
Melbourne, Australia.

Editorial & Advertising Offices
381 Fourth Avenue
New York City

National Advertising Manager
Boone Mancall

OUR PLATFORM

To maintain always the integrity of the original policy of this publication: that it be a means of raising the standards of projection by a ceaseless campaign of education among the many thousands of projectionists in the United States and Canada.

That every available inch of space in each issue be devoted to this end.

That we be interested in neither the politics or the personalities involved in the politics of the International Alliance of Theatrical Stage Employees and Moving Picture Operators of any other group or body of projectionists, because such interference with internal affairs of labor organizations will make this a partisan and political paper and destroy its value to the craft which lies in educational work only.

That by maintaining our policy of education we will enjoy the support of projectionists everywhere for many years to come as we have enjoyed this support for the last five years as the leading projection publication in the country.

The Editors and Advisory Editors and the organizations with which they are affiliated do not necessarily endorse all the statements or opinions offered in this magazine. The author who signs an article assumes full responsibility for the statements it contains.

FOR BETTER, QUICKER SPLICES

. . . Use Eastman Sound Film Patches, together with the simple, precise registration block specially designed for them.

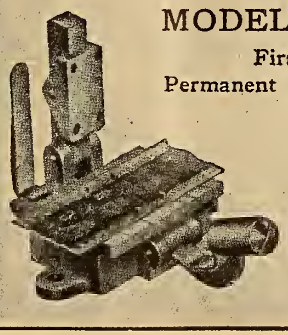
Here are the advantages of this combination:

(1) It gives clean, uniform splices.... in record time;
(2) it removes the necessity of painting out joints;
(3) the splices obscure a minimum of the sound track;
(4) they are practically inaudible in projection.

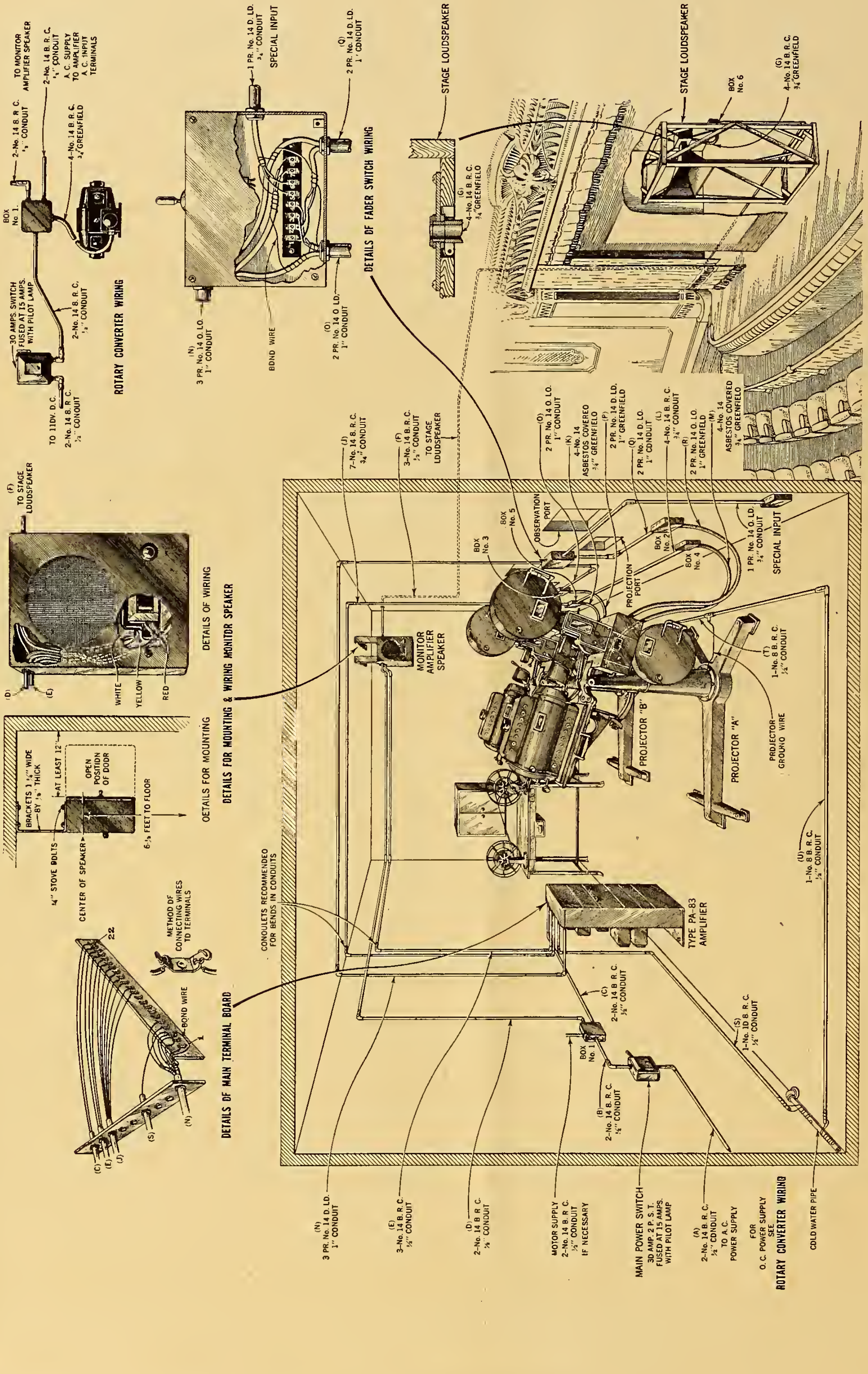
The adoption of this system represents an extremely profitable investment, especially since it involves only these nominal costs: Eastman Sound Film Patches (per thousand), $5.00; Eastman Sound Film Patcher (registration block), $4.25. Eastman Kodak Company (J. E. Brulatour, Inc., Distributors. New York, Chicago, Hollywood).

EASTMAN
SOUND FILM PATCHES

Universal Film Splicing Machine



MODEL NO. 3 Pat. March 22:22
First-Class Results on New or Old Film
Permanent Gauge No Adjusting
FOR THEATRES, EXCHANGES
LABORATORIES, SCHOOLS
Price $6.00
GENERAL MACHINE CO., INC.
816-826 East 140th St., NEW YORK, N. Y.
For sale by all Supply Dealers


ROTARY CONVERTER WIRING
TO 110V. D.C.
2-No. 14 B.R.C. 1/2" CONDUIT
30 AMPS SWITCH FUSED AT 15 AMPS. WITH PILOT LAMP
2-No. 14 B.R.C. 1/2" CONDUIT
BOX No. 1
2-No. 14 B.R.C. 3/4" CONDUIT
TO MONITOR AMPLIFIER SPEAKER
2-No. 14 B.R.C. 3/4" CONDUIT A.C. SUPPLY TO AMPLIFIER A.C. INPUT TERMINALS
4-No. 14 B.R.C. 3/4" GREENFIELD
DETAILS OF FADER SWITCH WIRING
(N) 3 PR. No. 14 O.LD. 1" CONDUIT
BOND WIRE
(O) 2 PR. No. 14 O.LD. 1" CONDUIT
1 PR. No. 14 D.LD. 3/4" CONDUIT SPECIAL INPUT
(Q) 2 PR. No. 14 D.LD. 1" CONDUIT
STAGE LOUDSPEAKER
(G) 4-No. 14 B.R.C. 3/4" GREENFIELD
STAGE LOUDSPEAKER
BOX No. 6
(G) 4-No. 14 B.R.C. 3/4" GREENFIELD
(F) TO STAGE LOUDSPEAKER
(D)
(E)
WHITE
YELLOW
RED
DETAILS OF WIRING
DETAILS FOR MOUNTING & WIRING MONITOR SPEAKER
BRACKETS 1 1/2" WIDE BY 1/8" THICK
AT LEAST 12"
OPEN POSITION OF DOOR
1/4" STOVE BOLTS
CENTER OF SPEAKER
6 1/2 FEET TO FLOOR
DETAILS FOR MOUNTING
22
METHOD OF CONNECTING WIRES TO TERMINALS
BOND WIRE
1
(C)
(E)
(J)
(S)
(N)
DETAILS OF MAIN TERMINAL BOARD
CONDULETS RECOMMENDED FOR BENDS IN CONDUITS
(J) 7-No. 14 B.R.C. 3/4" CONDUIT
(F) 3-No. 14 B.R.C. 1/2" CONDUIT TO STAGE LOUDSPEAKER
MONITOR AMPLIFIER SPEAKER
BOX No. 3
BOX No. 5
OBSERVATION PORT
(O) 2 PR. No. 14 O.LD. 1" CONDUIT
(K) 4-No. 14 ASBESTOS COVERED 3/4" GREENFIELD
(P) 2 PR. No. 14 D.LD. 1" GREENFIELD
(Q) 2 PR. No. 14 D.LD. 1" CONDUIT
(L) 4-No. 14 B.R.C. 3/4" CONDUIT
(R) 2 PR. No. 14 O.LD. 1" GREENFIELD
(M) 4-No. 14 ASBESTOS COVERED 3/4" GREENFIELD
BOX No. 2
BOX No. 4
PROJECTION PORT
1 PR. No. 14 O.LD. 3/4" CONDUIT SPECIAL INPUT
PROJECTOR "B"
PROJECTOR "A"
(T) 1-No. 8 B.R.C. 1/2" CONDUIT
PROJECTOR GROUND WIRE
(U) 1-No. 8 B.R.C. 1/2" CONDUIT
TYPE PA-83 AMPLIFIER
(C) 2-No. 14 B.R.C. 1/2" CONDUIT
BOX No. 1
(B) 2-No. 14 B.R.C. 1/2" CONDUIT
(S) 1-No. 10 B.R.C. 1/2" CONDUIT
(N) 3 PR. No. 14 D.LD. 1" CONDUIT
(E) 3-No. 14 B.R.C. 1/2" CONDUIT
(D) 2-No. 14 B.R.C. 1/2" CONDUIT
MOTOR SUPPLY 2-No. 14 B.R.C. 1/2" CONDUIT IF NECESSARY
MAIN POWER SWITCH 30 AMP. 2 P.S.T. FUSED AT 15 AMPS. WITH PILOT LAMP
(A) 2-No. 14 B.R.C. 1/2" CONDUIT TO A.C. POWER SUPPLY
FOR D.C. POWER SUPPLY SEE ROTARY CONVERTER WIRING
COLD WATER PIPE

"Wired for Sound"

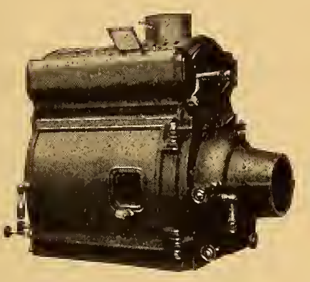
Pictorial drawing showing at a glance units and wiring of typical sound projection installation.

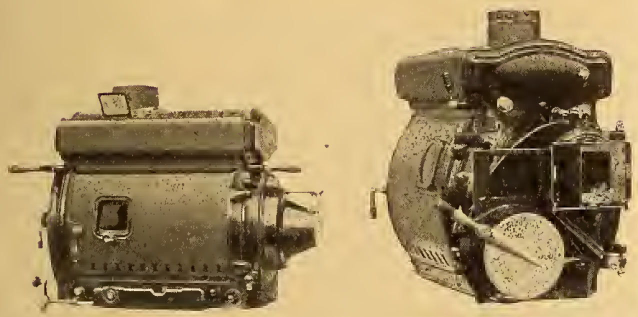
Courtesy, RCA-Victor Company.

Brenkert

Projection Lamps

in theatres from coast to coast are daily producing highest quality projection at low operating cost.





Super High Intensity — Hilow — Standard Intensity

A size and type to meet any projection requirement. Sold and serviced by independent supply dealers.

WRITE FOR LITERATURE

A Brenkert PRODUCT

CORRECT DESIGN—PRECISION CONSTRUCTION

BRENKERT LIGHT PROJECTION CO.
Engineers & Manufacturers
ST. AUBIN AT EAST GRAND BLVD., DETROIT

A perfectly balanced complete sound-on-film projector unit in which perfect synchronization of SIGHT and SOUND is accomplished.

For the Theatre of Moderate Size

The new Simplex-Acme Sound-Projector offers an unusual combination of mechanical excellence and economy of operation for the theatre of moderate size. Here is a finished product, incorporating all the latest developments — a compact precision-built unit that has already set a new standard of quality for projection and sound reproduction in small and medium-sized theatres .... You are urged, in your own interest, to see this remarkable unit in operation at your nearest National store.

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

Measuring Instruments -- Direct Current

By A. H. WOLFERS*

LITTLE practical use can be made of electricity unless it is very definitely controlled and measured. These measurements are carried out with instruments specially designed to accomplish this purpose.

In order to realize the full value of such instruments a knowledge of the principle or operation and the mechanical make up is of considerable assistance.

Let us first examine the assembled internal construction of a **direct current** permanent magnet, movable coil type of instrument as shown in Fig. 1.

The essential parts of this type of instrument are a permanent magnet and a movable coil made up of several turns of wire carefully insulated and wound upon an aluminum frame. The coil carries the pointer of the instrument. It is pivoted in sapphire bearings to rotate between the pole pieces of the magnet. Attached to the frame of the coil are two spiral springs (Fig. 2). These springs oppose the movement of the coil and serve also as conductors to carry current into and from the winding.

When a current is passed through the coil it becomes an electro magnet and the lines of force in its magnetic field tend to align themselves with those of the permanent magnet. This causes the moving system to turn in its bearings and the rotation is obtained as indicated by the pointer attached to it, this deflection being directly proportional to the strength of the current. The moving system attains a position of equilibrium when the opposing force of the springs equals that of the rotary action imparted to the coil by the magnetic field. The pointer moves over a precisely calibrated scale and indicates the value of the current being measured.

So much for the principle of operation. In applying this principle to a measuring instrument, however, it is essential that each operative part be precisely designed and manufactured if the instrument is to give uniformly dependable results.

The Permanent Magnet

Let us, therefore, now consider the field of the permanent magnet used in such an instrument. (Fig. 3) As in any permanent magnet the lines of force entirely surround the magnet. However, only those passing directly between the poles are of use in the operation of this instrument.

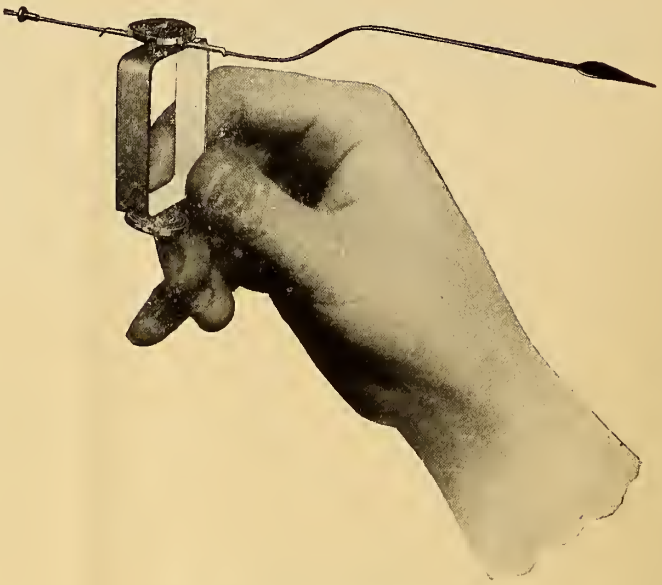


FIG. 2—*The Movable Coil.*

These useful lines of force forming the field in the space where the movable coil rotates normally consist of nearly straight lines passing between the poles. However, as we shall see, such a distribution of lines of force does not serve our purpose.

The next step in the construction of the magnet system is the addition of pole pieces attached to the ends of poles of the magnet. (Fig. 4).

As will be observed from the figure, the addition of these pole pieces has the effect of concentrating the useful magnetic lines which now form a ring on the faces of the pole pieces. But there still remain some lines in the center which are still parallel and have not taken the uniformly radial position which is desired. The radial position of these lines is the ideal that is sought since it gives a concentrated and uniform field throughout the path of rotation of the moving coil. To obtain this radial field, a cylindrical core of soft iron is inserted. The field we have with the introduction of the core is seen in Fig. 5.

To permit freedom of rotation of the movable coil within this radial magnetic field, core and pole pieces must be exactly concentric and the air gap between accurately established. This is one of the precise mechanical operations necessary in the manufacture of such instruments. The air gap for an average instrument is made 0.05 inch in width, i.e., the annular space between the pole piece and core through which the moving coil travels is 0.05 inch wide.

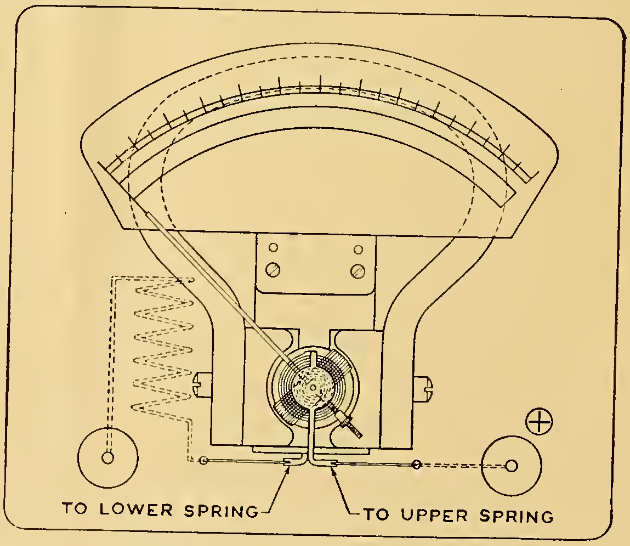


FIG. 1—*Construction of Typical D. C. Movable Coil Instrument.*

---

* Engineering Department Weston Electrical Instrument Corporation.

Another point of importance regarding the magnet is the method used to assure its permanency. It is well known that a magnet which is supplied with a keeper or piece of soft iron will retain its magnetism longer than with no keeper. When this keeper is properly designed the magnetism will remain unimpaired, as the keeper provides a path of low reluctance for the lines of force.

As has been stated above, the pole piece and the core are both made of soft iron and the distance between them is minutely small. It may be seen that this construction, in effect, provides the magnet with a keeper. In other words, the air gap is so small that it does not disrupt or impede the path of the lines of force to an appreciable extent. The magnet, therefore, retains its force throughout an indefinite period of years.

The Movable Coil

The movable coil is to this type of electrical measuring instrument what the geneva movement or star is to the motion picture projector. It is the heart of the movable system. As has been noted, it is made up of several turns of wire carefully insulated and usually wound on an aluminium frame. Its parts are so designed and constructed that their weight is reduced to the minimum consistent with requisite mechanical strength. This is most important since excessive weight in the movable system causes friction which impairs the response of the coil to changes in current and results in an early wearing out of the pivots. The size of the coil depends upon the instrument in which it is used. The coil shown in Fig. 2, is taken from a switchboard voltometer, its dimensions being roughly 1 x 1⅝ inches. In one popular precision measuring instrument the movable system weighs less than 0.2 gram, although it consists of sixteen parts. Some of these parts are so small that in order to learn their exact form they must be examined under a magnifying glass. Yet, their mass is distributed with such nicety that the center of gravity of the complete assembly is almost exactly aligned with the pivots. This alignment is finally perfected by means of minute adjustable nuts on the cross arms and tail piece of the pointer.

The projectionist may, at first thought, conclude that due to the minuteness of these parts such instruments are too delicate for commercial work. It must be remembered, however, that the only mechanical function of the parts is to carry the pointer over the scale. As a matter of fact, the parts are more than adequate in size and strength for the work for which they are intended, even when allowance is made for incidental overloads and shocks of ordinary character.

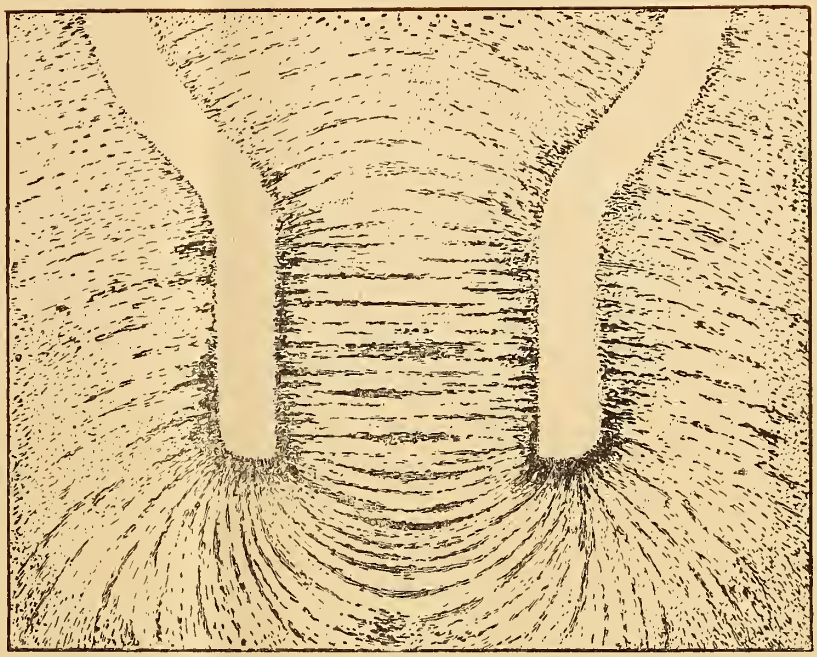


Fig. 3—*Lines of Force of a Permanent Magnet.*

Another point to be noted in discussing the action of the moving coil is the way in which it is "damped" — in other words the manner in which its motion is slowed down to prevent excessive overswing and oscillation before it settles to rest at its final position.

Since the coil is wound on an aluminum frame, currents are induced in it as it rotates through the field of the permanent magnet. These currents are known as eddy or Foucault currents, and since they are produced by the oscillation of the coil, they absorb energy from the movable system and greatly diminish the amplitude of the swing, quickly bringing it to rest. The slight oscillating swings serve to assure the user of the instrument that there is no friction present.

The Voltmeter

Ohm's Law asserts that the current in a circuit is directly proportional to the electromotive force and inversely proportional to resistance of the circuit. In order to make use of the current strength to measure voltage, it is necessary to pass it through a known and fixed resistance in series with the movable coil, so that the current will depend wholly upon the voltage applied. It is usually desirable and often necessary to have the instrument resistance very high so that the current used

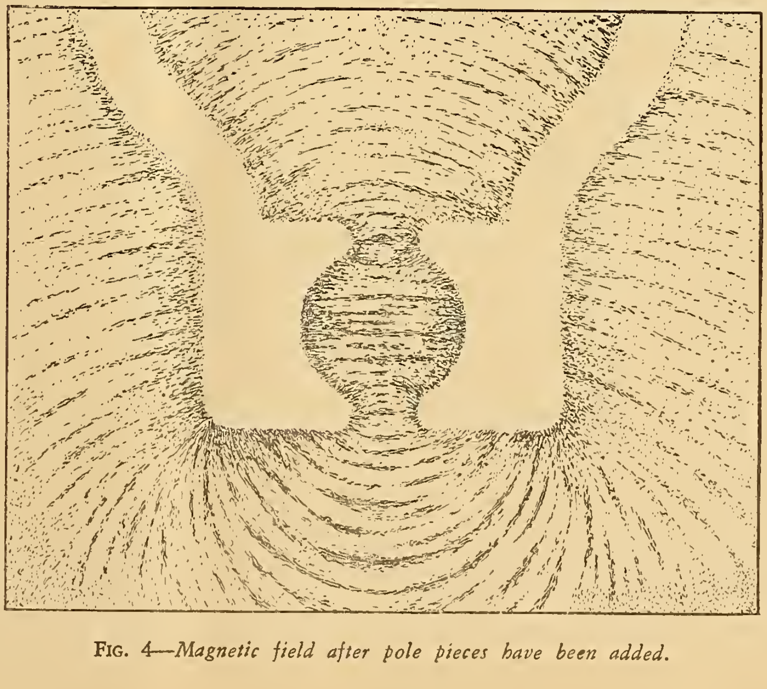


Fig. 4—*Magnetic field after pole pieces have been added.*

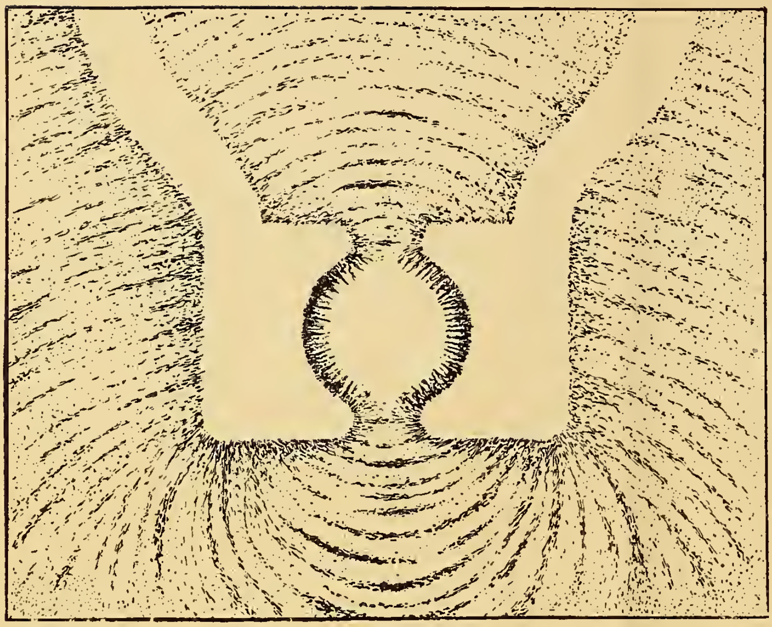


FIG. 5—*Lines of force of a Permanent Magnet with Pole Piece and Core.*

will not seriously affect the circuit whose voltage is to be measured.

Thus, in order that the voltmeter shall indicate the pressure sending current through a conductor, such as a lamp, it is necessary to connect it across the terminals of the lamp. This method of connecting is called parallel, or shunt, connection.

Voltmeters are always connected across the terminals of the device to be measured.

Due to the uniformity of these instruments in all respects they can be made with one or more ranges. For instance, to make a voltmeter having a range of 150 volts and some lower range such as 15 volts, it is only necessary to tap the series resistance used for the 150 volt ranges at the point that will give the instrument the required resistance for the lower range or ranges desired. If these ranges are so chosen that they are the proper multiples, or sub multiples of each other, their values can most readily be marked on the same scale.

Whenever space is available the series coils are contained in the case of the instrument.

The Ammeter

The development of the dynamo for producing large currents created an immediate demand for an apparatus by means of which such currents could be measured. It was natural that most inventors should attempt to construct current indicators based upon the scheme of using a solenoid carrying the entire load.

In this connection we find it convenient to borrow an illustration and a description from a popular text book, as follows: "A simple arrangement (Fig. 6) is often used as an ammeter when a cheap instrument for rough measurement is required. The current flowing through the low resistance coil C, sucks the soft iron plunger A, pivoted at P, up into the coil. This causes the pointer through the coil C. The control is affected by means of the weight W, called a 'gravity' control and damping is accomplished by means of the eddy currents in the plunger A. Neither the damping nor the control is good, due to the comparatively large masses of the moving parts, the large amount of inertia and the friction on the pivot. Moreover, an instrument of this type has large errors, owing to hysteresis or lag, due to the excessive mass of its movable iron parts."

A much better plan than using a solenoid, or, in fact, any device which is operated by sending the entire current through it, is to divide the current and construct the instrument in such a way that it carries only a small part of the total current. For instance, in Fig. 7, sub-A, the only path for the current is through the instrument. Suppose we did not know whether this current amounted to less than 1 ampere or over 100 amperes and the instrument was of single range and intended to carry not over 1 ampere; then it would not be safe to throw on the full load. On the contrary we would be obliged to increase it gradually and if we found that it was greater than one ampere, we could divide it up by using another instrument in multiple with the first, as shown in Sub-B and their readings added together would, of course, give the total current. We could employ three or more instruments in this manner, but this would be a clumsy and expensive method.

The best arrangement is obtained by the introduction of a shunt in the circuit.

The Shunt

If we look up the definition of the work "shunt"' we will find that in England it originally meant a sidetrack for turning off a car or train from the main track. It is what we call a "switch," particularly one which branches off from the main road and joins it again farther on.

An electrical shunt is in a sense similar to a railroad shunt, since it is used to sidetrack part of the current flowing through a conductor. To fully understand the object and principle of shunts for current indicators, it is only necessary to study Sub-C. Consider the case of an instrument and a resistor or shunt which we

(*Continued on page* 27)

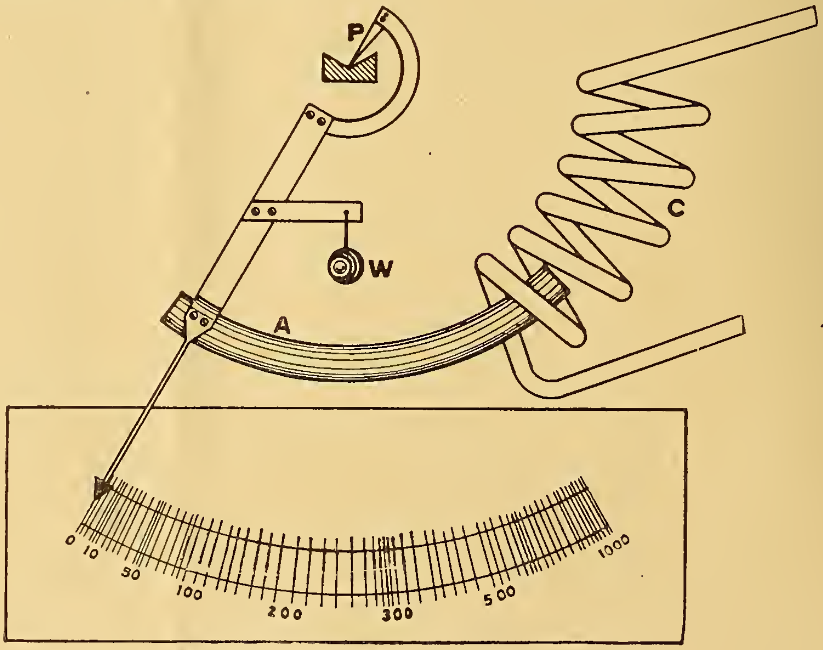


FIG. 6—*A Solenoidal Meter, Gravity Control.*

The Symmetrical Sound Track

By CECIL B. FOWLER

IN our article in the October issue of this magazine, describing the new recording system developed by the RCA Victor Company, we added a note to the effect that there seemed to be some points regarding the new sound track which still were open to discussion. Additional information on the new system having since been available, we are now able to supplement this part of the article.

From the description given at the audition we attended, we concluded that the superiority of the new track lay wholly in its symmetrical area. We accordingly confined our discussion in this part of the article to a comparison of the symmetrical track with the early track in terms of ground noise ratio. While this comparison itself was not in error, it failed to bring out the fact that the minimizing of ground noise by the new system is not mainly inherent in the track, but is rather the result of certain improvements in design and operation which the symmetrical area makes possible.

The Hanna System

It might be remarked that attempts to reduce ground noise were made before the development of either the shutter system or the symmetrical track, experiments along this line having been carried out by C. R. Hanna and L. T. Robinson, engineers respectively of the Westinghouse and General Electric Companies, in the early days of talking pictures. A commercial method based on the result of these experiments was introduced by H. McDowell Jr. of RKO studios in 1929.

In the Hanna system, it was attempted to minimize the ground noise area on the sound track by shifting the base line of the recorded wave to within a few mils of the edge of the track, as the amplitude of the signal approached zero. When the volume increased, the base line was brought back towards the center of the track. This, in effect, might be visualized as pushing the surplus white area off the edge of the track and bringing it back as soon as its use was required in the recording of higher amplitudes. Besides being an ingeniously simple one, this idea was quite practical when applied to recording. Its disadvantage was found in reproduction, when in the case of a bad "weave" in the projector, the scanning beam would miss part, if not all of the wave which had been recorded near the edge of the track.

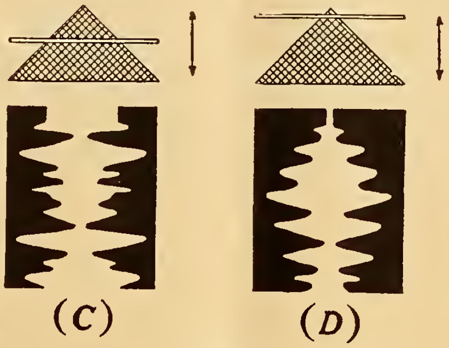


FIG. 2

The Shutter System

It appears that the next means for reducing ground noise was that introduced shortly before the advent of the symmetrical track. This is the system in which a shutter is used for blocking out part of the unwanted area (Fig. 1, A). We made only brief mention of this system in our last article, but shall now refer to it more fully since the operation of the shutter and that of the biasing feature of the new system are similar.

As can be seen from the figure, the shutter moves to the right or left across the recording slit. The direction of this movement depends upon the varying amplitude of the wave being recorded. When zero modulation is approached, the vane moves to the right and blocks that portion of the light beam which would otherwise produce a surplus white area on the track. As the modulation increases again, the vane moves to the left allowing fuller use of the beam. This operation results in the masking of the white area in proportion to the useful sound recorded, as seen in the figure.

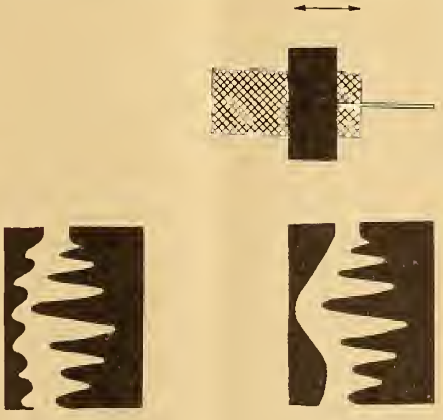


FIG. 1

The Symmetrical Track

In the symmetrical track, a similar result is effected by controlling the position of vibration of the light beam with respect to the recording slit. It will be recalled from the previous article that the galvanometer mirror from which the light beam is reflected, is tilted by an armature made to vibrate by the electromagnetic action of the pole pieces between which its lower part is fixed and the two coils which surround its free end. One of these coils, the voice coil, carries the audio frequency currents from the recording amplifier. The other is energized by a biasing current obtained by diverting a portion of the signal. The mirror reflects a triangular beam of light which moves vertically across the recording slit (Fig. 3) the length of the segment of light cut by the slit varying with the position of the beam.

With the tip of the triangle across the recording slit (Fig. 2-D) the resulting white area is the narrow strip seen at the top of the sound track. When the triangle has moved upward so that its base is near the slit, the white area extends across the track. But it is only in cases of sudden changes from no sound to loud sound, or vice versa that the beam moves directly from one extreme position to the other. In recording a wave of ordinary variation of amplitude, the movement of the triangle between these two positions is in the form of a number of small vibrations which are the result of the current flowing in the voice coil of the galvanometer. The intermediate positions or mean positions of vibration are controlled by the biasing coil. Thus when the signal falls to low volume, the biasing action moves the triangle to the position shown in (D) of the figure. At this point, its vibrations in response to the voice coil result in small white peaks such as those seen at the top of the track in the illustration. When there is an increase in volume, the bias is changed and the triangle vibrates about a new mean position. For small volume, the beam is shifted only slightly, but for full volume it is moved so that the triangle is in the position seen in (C). Without bias, the average width of the clear area would be the same whether the amplitude of the vibrations were small or large. It may be noted that shifting the mean position of vibration of the beam; as has just been outlined, corresponds to changing the position of the base line of the wave as was done in the Hanna system discussed above.

The Biasing Current

The current that operates the shutter vane, or in the new system energizes the biasing coil of the recording galvanometer, is obtained by rectifying and filtering a portion of the sginal. In both cases, the filtering of this current is important and involves some interesting considerations.

The current as rectified, is a pulsating one, the frequency of pulsation depending on the frequency of the rectified wave. Since it is necessary first to remove all audible components from the current, a low pass filter is employed which eliminates practically all of the fluctuations except those of such low frequency as to be inaudible in the reproducing system.

In doing this, the filter serves another purpose. The shutter must at no time move fast enough to record a wave of audible frequency, otherwise the outline of the black mask will also be reproduced as sound (Fig. 1 - B) obviously causing distortion. Similarly, in the case of the symmetrical track, the movement of the light beam as a result of the bias winding of the galvanometer must not produce audible sounds in the finished record. Test sound tracks, made by recording with the biasing winding alone connected, show long smooth curves. If these are audible when the film is run through a reproducing machine, the filter is inadequate.

On the other hand, it is important that the filtering be no more drastic than is necessary, since filtering limits the speed with which the track can be opened up when a rapid increase of the sound volume occurs. However, it is an interesting fact that the occurences of extremely rapid building up of sound are in practice much less frequent than might be supposed. Examinations of recordings of percussion instrument tones and words beginning with explosive consonants show an appreciable time required in building up to their maximum amplitude. In many cases, this is no doubt due to the fact that maximum amplitude is not reached until the sound has been reinforced by a certain amount of room reverberation. Moreover, while certain very rapid increases of intensity may actually result in the first few waves being overshot, careful observations have proved that the absence of the few waves, that are lost with the opening up speed employed cannot be discerned. Part of the reason for this is probably that sudden increases of sound volume are in nature always preceded by a certain amount of extraneous sound and therefore cutting off of two or three peaks does not alter the effect

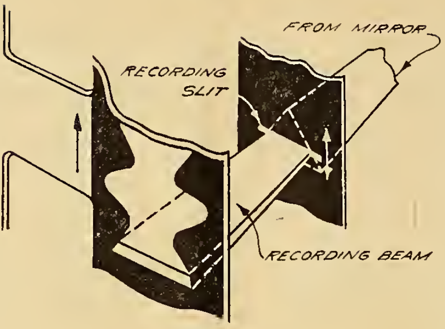


FIG. 3

The Envelope Curve

The ideal movement of the shutter or shift in galvanometer armature by the bias winding would, of course, be in strict accordance with the envelope of the useful sound. In other words, the black mask made by the shutter would touch the tops of all the black peaks, while in the case of the symmetrical track, the triangle would for zero modulation be biased so low as to shut off all light from the film at that point.

However, in practice this is not possible. For one reason, an envelope curve that followed the wave curve so closely would, it will be seen, introduce the objection mentioned above namely, a wave capable of reproduction in addition to the original sound. Another reason is that in complex waves where high frequencies were superimposed on waves of very low frequency, an envelope close enough to follow all high frequencies would obliterate the low frequency components. Both of these possibilities are avoided if the speed of the biasing movement is fixed below that which would result in its producing an audible wave.

Following the envelope of the recorded sound with extreme closeness is, in fact, not of great importance for when the wave is of high amplitude the useful sound is itself so loud as to drown the ground noise. It is at times when the volume of the useful sound drops, as for example during low passages of music or lapses in dialogue, that the ground noise becomes noticeable. Therefore it is to narrow the clear area of the track at these points that the biasing action is primarily designed.

Operation of Biasing Circuit

The biasing circuit used in recording the symmetrical track operates in the following manner:

Instead of setting the galvanometer mechanically to put the light beam in position (D) and applying a rectified current which shifts it to position (C) for full modulation, the reverse is done; the galvanometer is adjusted mechanically to position (C). The rectified voltage is applied to the grid of a tube in such a way as to reduce the plate current, the amount of reduction being proportional to the amplitude of the audio frequency winding of the galvanometer. When there is no modulation, there is sufficient plate current to bias the galvanometer to position (D). When there is modulation, the plate current is reduced and the galvanometer approaches position (C). The system is so designed that full modulation brings the tube current to practically zero and the vibration is then about the central position where it should be for full modulation.

The advantages of working in this manner are, first, that any failure of the rectifier system would result in the galvanometer immediately going to the mid position and the recording would not be spoiled, even though it lost the benefit of ground noise reduction. In the second place, since the tube current is reduced to zero at full modulation, there is no danger through too high setting of the gain in the rectifier-amplifier of shifting the beam to a position such that the slit is too close to the base of the triangle. The gain in the rectifier-amplifier is, therefore, not critical and at times of full modulation, when it is important to have the beam accurately centered in order to permit maximum modulation, the tube plate current is zero and this condition is assured.

Conclusion

It is apparent that the biasing movement as operated in the new system is an improvement over a separate mechanical means for performing the same function. Besides being more likely to get out of adjustment, the use of a shutter in the old system introduced the factor of inertia. While this had not been found to be a serious handicap in its operation, it was one of the chief considerations which necessitated a more restricted design of the circuit than with the symmetrical track. The filtering system used with the new track makes it possible to follow the envelope curve of the wave more closely than before and so the symmetrical track has some advantage over also the shutter system in the minimizing of ground noise. This, it must be remarked, was not brought out in (B) of Fig. 3 in the first article, since this group of sketches was made to show how the three systems worked and not to illustrate differences in the ground noise areas of the tracks they produced. In (A) of Fig. 1 of this arti-

(*Continued on page* 31)

Portable Power Supply

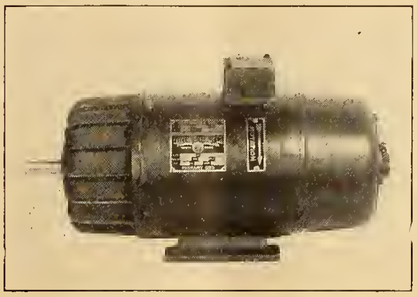
By WM. H. HAINES*

THE portable sound picture projectors which are now in use in considerable numbers are usually plugged into the available lighting sockets, and they are designed to operate from 110 volts, 60 cycles, single phase. Frequently these projectors must be used in locations where some other source of power is available, or in locations where there is no source of power at all.

To operate these projectors from direct current circuits, a converter with a filter is necessary for changing direct curent into 60 cycles alternating current. The converter must, of course, be small, compact, of light weight, and should be provided with convenient carrying handle. All operating parts should be completely protected, and convenient plug receptacles should be furnished so that it may be easily plugged into the D.C. lighting line, and so that the projector may be easily plugged into the converter. These converters are usually operated at the comparatively high speed of 3600 RPM in order to keep the size and weight within reason, and they must, therefore, be very carefully balanced dynamically, so as to operate quietly. Sleeve bearings, with wool packing, provide the most convenient form of lubrication, and insure quiet operation.

Speed Regulator

In some cases the direct current lighting line is subject to sudden and violent changes in voltage, which might cause unsatisfactory operation of the projector unless provision is made in the converter for correcting the converter speed, and therefore the output frequency, for changes in primary voltage. This can be accomplished by the use of an automatic speed regulator, which maintains the speed, and therefore the output frequency, constant for a wide range of primary direct current voltage. The regulator consists of contacts actuated by weights acted upon by centrifugal force, and acting against springs. When the speed tends to increase the weights close the contacts short circuiting a resistance in the motor field, thus strengthening the field, and reducing the speed. When the speed decreases, the contacts are opened, connecting a resistance in the field, and increasing the speed. By this means the frequency, and therefore the speed of the projector motor is maintained constant for wide variations in the direct current supply voltage.



Self-excited A. C. Generator.

Frequency Changing Sets

In many cases portable projectors must be operated from 25 cycle supply, and it is not usually feasible to design 25 cycle motors, gearing, and amplifiers, as the number of outfits required for 25 cycle operation is usually small. Frequency changing motor generator sets are usually used for supplying 60 cycles from the 25 cycle line.

In such a set the 25 cycle motor must necessarily operate at about 1450 RPM, and the nearest to this speed at which the generator may be operated is 1800 RPM. The motor and generator are mounted on a suitable aluminum base, and the motor drives the generator by means of a "V" belt drive, which enables the machines to be mounted very close together, to form a compact, self-contained outfit. Suitable guards are provided over the belts and pulleys, and convenient carrying handles are arranged on the ends of the base. Such a machine designed to operate one of the standard 16 mm. portable projectors weighs about 145 lbs. complete.

Primary Sources

One important application of the portable projectors is on trucks, for advertising and campaign purposes. The projector and amplifying equipment are installed in the truck with screen usually placed at the rear. The problem is, of course, to supply sufficient 60 cycle, A.C. power to properly operate the equipment. Several different methods are being used.

One method is to install a 32 volt storage battery of sufficient capacity to operate a converter with filter, which will convert the 32 volts D.C. into 60 cycles A.C. Usually about 300 watts is sufficient to operate a 16 mm. portable projector. A suitable converter would weigh about 55 lbs., and would draw approximately 16 amperes at 32 volts when operating under full load. A 32 volt storage battery therefore, of about 130-160 ampere hours' capacity should be installed to operate the converter. In many cases it is not convenient to keep such a storage battery charged, in which case a primary source of power is desirable.

Gasoline-Electric Power Unit.

One primary source of power often used is the self-contained gasoline engine driven electric generator set. A gasoline engine is mounted on a suitable channel iron base, and drives through a flexible coupling a self-excited 60 cycle alternator. Special mufflers are provided to take care of the exhaust noise, and it is also usually necessary to install the sets on rubber, and to use sound absorbing material on the walls of the compartment, to absorb the mechanical noise of operation of the engine. There is, of course, some noise to be taken care of, but many entirely satisfactory installations of this kind are being made. In the smaller sizes 4 cycle, single cylinder, air-cooled engines, and for the sizes of 2000 watts or more, multi-cylinder, water-cooled engines are usually supplied. The air-cooled engines are used for sizes generally required for operating portable projectors.

Another Source

Another primary source of power which has proven very satisfactory, is a self-excited, A.C. generator, which is driven from the fan belt of the main engine of the truck. An automatic speed regulator of mechanical design is built in with the generator which maintains the generator speed constant through a wide variation of engine speed. The machine delivers both constant voltage and constant frequency when the engine speed varies.

These governed generators are usually installed on brackets alongside the engine, and driven by means of "V" belts from the pulley on the engine crank shaft, which drives the fan. A convenient field rheostat is used for fine adjustments of the voltage, and filters may be supplied, enabling the machine to be used also for operating a radio receiver if nec-

(Continued on page 18)

---

* *Engineer, Electric Specialty Company.*

Better Times Coming, Says Electric Head

By A. W. ROBERTSON*

The contrast between the present and a year ago is marked. A year ago business was running downhill with the brakes off. Now we are no longer going downhill and in some quarters business has improved substantially, although the general standard of business throughout the country is still very low. The future is uncertain and vague in detail but we can see enough to know that 1933 will be a year of gradually improving business. The most hopeful sign is the improved point of view of industrial leaders. The discouraged have passed out of the picture and men of courage and youth are in command.

Everyone realizes that our economic life would be greatly stimulated by some outstanding discovery which would become tremendously popular, making many new jobs and stimulating business generally. I do not think such development imminent nor do I regard it as essential to recovery. The restoration of our factories, commercial buildings, institutions and homes to anything like first class condition after three years of depletion will in itself provide the stimulus we need. Industrial leaders are beginning to recognize this and are planning programs of rehabilitation and modernization on the basis of insuring future earnings. Storekeepers, landlords and home owners are bound to take part in this movement in their own self-interest and when the snowball gets to rolling it will assume mountainous proportions

The development of the electric power industry has temporarily halted and their budgets do not call for much expansion during 1933. The industry, due to the depression and the mistakes of the boom period, is suffering from attacks made upon it by public officials. It is our opinion that it will take a little time to clear away these clouds. This is another case of the many sufferings for the few who are guilty. In a relatively short time the power industry will emerge as one of our greatest industries.

This depression has taught the world we must stand together or perish and it is marvelous how well we are holding together considering the difficulties we are facing due to the amount of unemployment which still exists. Those who are caught in the economic distress are showing remarkable patience and fortitude. On the other hand those still employed are helping out more and more. As a result we are muddling through with a minimum of grief and suffering.

I expect to see a material improvement in business in the next twelve months. This is based on the assumption that our next President will surround himself with wise counsellors and the matter of international debts and tariffs will be settled with reasonable dispatch and good sense.

---

* *Chairman, Westinghouse Electric & Manufacturing Co.*

PORTABLE POWER SUPPLY

(*Continued from page* 17)

essary. With this arrangement, it is, of course, necessary to operate the main engine of the truck whenever the projector equipment is in use, but the generating equipment occupies less space, and is of considerably lighter weight than the gasoline engine generator sets. In general when the power required is not over 350 watts, the governed generator is the most satisfactory arrangement. For larger powers, the gasoline engine generator sets are more suitable.

WHY SHOULD I BUY NOW?

RIGHT now when competition is keenest - it's the house with the best pictures that makes the profits.

Super-Cinephor gives your shows a big break. Clear, sharp definition right to the edge of the screen - gives your patrons eye comfort - makes your features easy-to-watch. It makes your theatre their favorite. Perhaps they can't tell why they like your shows best - but it makes the difference between red ink and profits.

BAUSCH & LOMB OPTICAL COMPANY

Bausch & Lomb makes its own optical glass

680 St. Paul St. Only B & L glass meets B & L Standards. Rochester N. Y.

MICROSCOPES : TELESCOPES : BINOCULARS : SPECTACLES : LENSES and FRAMES
OPTHALMIC APPARATUS : SCIENTIFIC INSTRUMENTS

Here's a chance to make profits in a small investment.

Send the coupon

BAUSCH & LOMB OPTICAL COMPANY
680 St. Paul St., Rochester, N. Y.

Send me complete details on the Super-Cinephor Lens.
Name ....
Address ....
City .... State ....

Dr. Goldsmith Looks Ahead

By DR. ALFRED N. GOLDSMITH*

TO prophesy well is an art that requires the ability to look in opposite directions at once—the power of retrospection and of anticipation. But unlike Janus, we mortals are incapable of anticipating by mere mental imagery; another, and supervening process is required—that of deducing the prospect from the retrospect. In no other way can we envision the future; only the gods are spared the labor of logic, and can arrive at a knowledge of future fact independently of studying causes.

We can look forward only by looking backward. First we see what the past has produced, and under what circumstances; then we ask what can be developed from these products of the past, the circumstances remaining unchanged; and finally, we seek to know to what extent the form of these new developments may be influenced by a change of circumstance.

In other words, prediction is nothing more than reasoning from known facts to *probable* facts. Note the emphasis on probability. Nothing can ever be deduced with certainty unless all the facts of the case be known; and, of equal importance, all the possible counteracting influences be taken into account. Rationally, therefore, one can assign to a prediction only a certain degree of probability, which will vary according to his knowledge of the situation in all its phases, and upon his dexterity in the use of the logical processes.

One who forecasts risks the possibility of having his statements turned to ridicule. In any event, if one predicts at all, he must guard against letting the wish beget the thought. Sometimes, however, as at the present time, some of the circumstances or indications may be so strong as almost to guarantee a high degree of probability for our prophesy. In such cases, one may attempt to forecast with a minimum of risk provided only that he confine his prediction to generalities.

Production and Returns

The motion picture industry, as all other industries, is in great difficulty. Money is scarce, box-office receipts are lower, operating expenses and taxes still go on. Development work has been curtailed to a minimum, and it is difficult to supply even the reduced demand for productions that still exists. To determine what is to be done about it all is a prodigious problem, except in respect to certain action that under existing circumstances is plainly necessary.

There are two extremely important principles of business that must be carefully coordinated and weighed one against the other. The first is cost of production and the second, returns for service (or delivery of goods). The cost of production includes all costs—cost of management, cost of material, labor, development, distribution. The total cost must be at least balanced against the returns for the service or the goods delivered, and preferably, should be greater in order to provide for profits and expansion.

But under certain circumstances, it is difficult to balance the one against the other. When the returns decrease to such an extent as to obliterate the profit that originally existed, the various costs of production must inevitably be decreased. This necessitates cheaper material, cheaper labor, less development work, and cheaper methods of distribution. But in reducing these expenses, great care must be taken not to impair the producers's ability to render service or deliver goods at a rate greater than that at which he reduces his cost of production; otherwise, the returns for service or goods delivered will decrease still further and necessitate another reduction of costs, leading to a situation from which it may be difficult, if at all possible, for the producer to extricate himself.

There are other features of the adjustment, however, that are perhaps equally important. At the beginning the development work must be greatly accelerated in order to devise new and more economical forms of equipment (or goods), to try new and cheaper materials, and to reorganize the processes of manufacture and distribution so as to reduce the costs of labor and transportation. But in so doing, the producer or manufacturer must beware of so cheapening the construction or design as to impose new and additional burdens upon the users of the product or upon those who service it.

Perhaps the greater part of the cost-reduction phase has already been achieved; those who were sufficiently prompt in making this initial adjustment, are in a fair way likely to emerge from the experience all the better for it, provided that they use due discretion during the days to come. Every other adjustment that is to be made must be made in the light of its possible defeat at its own hands. Thus, the cost of management must not be reduced nor the personnel so restricted as to injure the efficient conduct of the business; every reduction of cost of material, labor, and distribution, must be so made as not to react in a damaging manner. Perhaps above all, the imprudence of marketing an inferior or even less desirable product—one in which the user or customer finds little satisfaction—must always be borne in mind.

The Theatre's Part

In particular, this refers in the motion picture industry to the quality of the strip of celluloid supplied to the theatres, to the visual and aural story imprinted upon it, and to the equipment in which it is used. These are the final products the benefits of which are passed on to the patron of the theater, upon whom the entire industry depends for its existence.

Particularly must be stressed the part that the theater will play in the complete adjustment and recovery of the motion picture industry; and in the motion picture industry this means projection. The production of saleable pictures is up to the producer. Given the picture and the sound on the film, how successfully the theater can sell entertainment to its patrons depends largely upon projection; which means, of course, the manner in which the film is handled and the machines are operated.

The motion picture industry seems, in general, to have recognized the truth and importance of these principles; it seems to have become thoroughly imbued with the doctrine of economy, and in some respects even have become somewhat extreme in adhering to it. But the pendulum swings always beyond its point of rest in all human activities, so that we can look forward with justified expectation to its eventual return,

---

* *President, Society of Motion Picture Engineers Former Vice-President, Radio Corporation of America*

The Day of the Journeyman Service E

The exhibitor can no longer bear the burden of service charges. Today this is an undisput fact. Exhibitors, individually, and in groups, are fighting to lift this burden so that they m continue to keep their doors open.

The struggle for relief has been on for months. Either a complete elimination or a very dra tic modification of these charges is due in a very short time.

The burden of caring and servicing of the sound equipment will fall on the projectionist. T exhibitor will gladly pay his projectionist a little more money for this extra service knowi that he is saving money and that his equipment is receiving daily care.

And the projectionist must be ready to assume this new duty with the same confidence a competence he showed when sound equipment first came into being.

The day of the journeyman service engineer is gone. But the projectionist must guard again his coming back by increasing servicing efficiency. Prepare yourself now for the new respo sibility.

SOUND TROUBLE

What this Valuable Manual Contains:

- Systematic Detailed Tests On Various Parts of Apparatus
- Exciter Lamp Socket Trouble
- Optical Systems
- Sound Gate
- Dampers
- Centering Sound Track
- Photocells
- The Photocell Transformer
- Summary of Sound Head Troubles
- Film-Disc Switch
- Turnable and Pickup
- The Magnetic Pickup
- Electrical Troubles in Pick-up Circuits
- Summary of Disc Troubles
- Fader Troubles
- Summary of Fader Troubles
- Amplifier Troubles
- Stage-by-Stage Testing of Amplifier
- Troubles in Western Electric Amplifiers
- Troubles in 46 Type Amplifiers
- Troubles in Loudspeaker Circuits
- Phasing Speakers
- Motors and Motor-Generator Sets
- Projector Drive Motors
- Alternating Current Projector Drive Motors
- Single Phase A. C. Drive Motors
- Motor-Generators
- Storage Batteries
- Trouble-Shooting in the Following Equipment:
  - Photophone PG-13(G)
  - Photophone PG-10
  - Photophone PG-8
  - Photophone PG-7
  - Photophone PG-6
  - Photophone PG-4
  - Photophone PG-3
  - "B" (SPU)
  - Photophone PG-28
  - Photophone PG-30
  - Photophone PG-39
  - Photophone Type PG-43
- The Western Electric 3-S-46
- The Western Electric 3-SX-46
- The Western Electric 2-S-41
- The Western Electric 2SX-41
- The Western Electric 1-S-41

SIMPLIFIED SERVICING of SOUND EQUIPMENT has been prepared to assist projectionists in replacing the service engineer.

As with all best craft and technical books it is not to be read and set aside. It is a reference volume to be placed alongside of your other tools in the projection room and to be used often and long. It is an indispensable tool for the efficient and proper operation and maintenance of your sound equipment.

Glance over the list of contents to the left. You will find your type of equipment listed. And this handy manual picks your equipment apart, traces the relation of every part to the rest and in simple quick fashion shows you how to make the proper tests when your equipment breaks down, and how to make the repairs so that the show may go on with the least loss of time.

Mr.
is one
East a
sound
sidiary
all his
to him
Throug
times i
counsel

Some
on pro
have b
reads t
one.

Fill i
and sen

Trouble Cause Delays -- Del

DO NOT DELAY . . . .

ngineer IS GONE

THE PROJECTIONIST MUST NOW TAKE OVER HIS WORK

AND THIS IS HIS INDISPENSABLE TOOL AND GUIDE

HOOTER

d Harding, the author of this manual,
e best known "trouble shooters" in the
or many years was an instructor in
ound troubles in RCA Institutes (sub-
CA). This book is the summing-up of
experiences plus the problems brought
rojectionists in and out of class hours.
is book he remains with you at all
ur projection room as your guide and

jectionists have bought many books
n; some have bought few and some
t none at all. No projectionist who
otice can afford to delay ordering this

e coupon to the right. Cut it out now
right back to us.

Causes Trouble
DER NOW

$2.00 we pay all postage

MANCALL BOOK CO.
381 Fourth Ave., N.Y.C.

Gentlemen:

Please send me Simplified Servicing of Sound Equipment. Enclosed find Two ($2.00) Dollars.

NAME ....

STREET ....

CITY ....

The Day of the Journeyman Service Engineer IS GONE

The exhibitor can no longer bear the burden of service charges. Today this is an undisputed fact. Exhibitors, individually, and in groups, are fighting to lift this burden so that they may continue to keep their doors open.

The struggle for relief has been on for months. Either a complete elimination or a very drastic modification of these charges is due in a very short time.

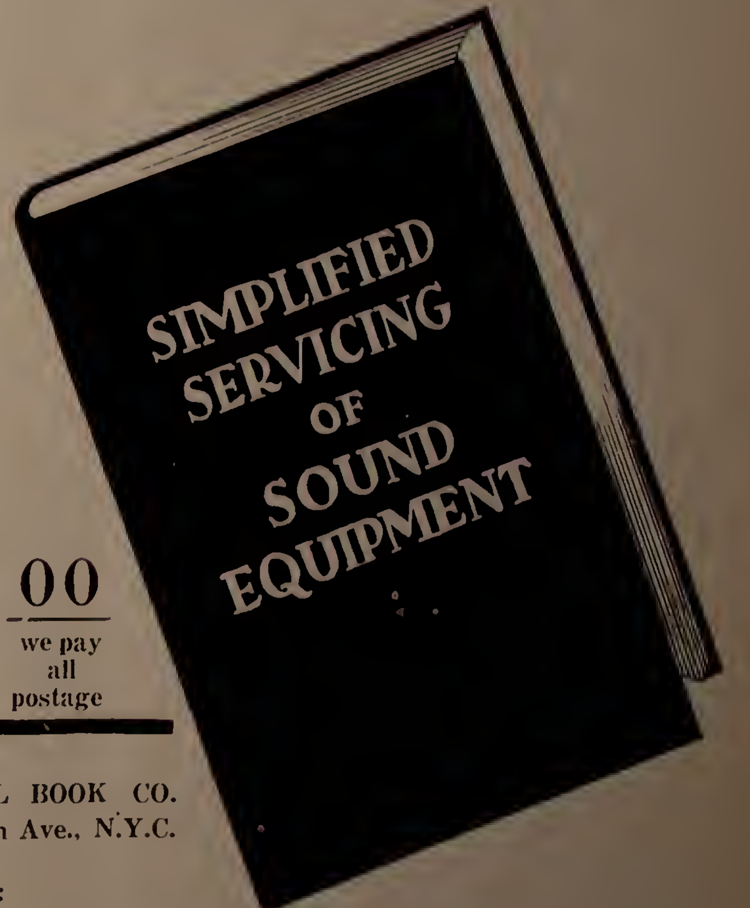
The burden of caring and servicing of the sound equipment will fall on the projectionist. The exhibitor will gladly pay his projectionist a little more money for this extra service knowing that he is saving money and that his equipment is receiving daily care.

And the projectionist must be ready to assume this new duty with the same confidence and competence he showed when sound equipment first came into being.

The day of the journeyman service engineer is gone. But the projectionist must guard against his coming back by increasing servicing efficiency. Prepare yourself now for the new responsibility.

THE PROJECTIONIST MUST NOW TAKE OVER HIS WORK

AND THIS IS HIS INDISPENSABLE TOOL AND GUIDE


SIMPLIFIED SERVICING OF SOUND EQUIPMENT

SOUND TROUBLE SHOOTER

What this Valuable Manual Contains:

Systematic Detailed Tests On Various Parts of Apparatus
Exciter Lamp Socket Trouble
Optical Systems
Sound Gate
Dampers
Centering Sound Track
Photocells
The Photocell Transformer
Summary of Sound Head Troubles
Film-Disc Switch
Turnable and Pickup
The Magnetic Pickup
Electrical Troubles in Pick-up Circuits
Summary of Disc Troubles
Fader Troubles
Summary of Fader Troubles
Amplifier Troubles
Stage-by-Stage Testing of Amplifier
Troubles in Western Electric Amplifiers
Troubles in 46 Type Amplifiers
Troubles in Loudspeaker Circuits
Phasing Speakers
Motors and Motor-Generator Sets
Projector Drive Motors
Alternating Current Projector Drive Motors
Single Phase A. C. Drive Motors
Motor-Generators
Storage Batteries
Trouble-Shooting in the Following Equipment:
  Photophone PG-13(G)
  Photophone PG-10
  Photophone PG-8
  Photophone PG-7
  Photophone PG-6
  Photophone PG-4
  Photophone PG-3
  "B" (SPU)
  Photophone PG-28
  Photophone PG-30
  Photophone PG-39
  Photophone Type PG-43
The Western Electric 3-S-46
The Western Electric 3-SX-46
The Western Electric 2-S-41
The Western Electric 2SX-41
The Western Electric 1-S-41

SIMPLIFIED SERVICING of SOUND EQUIPMENT has been prepared to assist projectionists in replacing the service engineer.

As with all best craft and technical books it is not to be read and set aside. It is a reference volume to be placed alongside of your other tools in the projection room and to be used often and long. It is an indispensable tool for the efficient and proper operation and maintenance of your sound equipment.

Glance over the list of contents to the left. You will find your type of equipment listed. And this handy manual picks your equipment apart, traces the relation of every part to the rest and in simple quick fashion shows you how to make the proper tests when your equipment breaks down, and how to make the repairs so that the show may go on with the least loss of time.

Mr. Lloyd Harding, the author of this manual, is one of the best known "trouble shooters" in the East and for many years was an instructor in sound and sound troubles in RCA Institutes (subsidiary of RCA). This book is the summing-up of all his own experiences plus the problems brought to him by projectionists in and out of class hours. Through this book he remains with you at all times in your projection room as your guide and counselor.

Some projectionists have bought many books on projection; some have bought few and some have bought none at all. No projectionist who reads this notice can afford to delay ordering this one.

Fill in the coupon to the right. Cut it out now and send it right back to us.

Trouble Cause Delays -- Delay Causes Trouble
DO NOT DELAY . . . . ORDER NOW

$2.00 we pay all postage

MANCALL BOOK CO.
381 Fourth Ave., N.Y.C.

Gentlemen:

Please send me Simplified Servicing of Sound Equipment. Enclosed find Two ($2.00) Dollars.

NAME ....

STREET ....

CITY ....

perhaps from a smaller swing.

This reasoning emboldens me to predict: Recognizing the psychological revulsion from the extreme, and the trends in the opposite direction that always occur after such a revolt; and keeping in mind that part of the adjustment that has already been made or is now in process of being made; I know of no reason why, if the general and obvious principles repeated here be followed consistently from now on, we should not experience steady and persistent, though slow, improvement of our fiscal conditions.

Patience is required. We can not easily or quickly overcome the obstacles before us; the period of convalescence from a wasting disease is generally longer than the acute period of the ailment, and it is a time during which a relapse must be guarded against.

Continued Development

In the motion picture industry, as in all others, perhaps the first phase, to be somewhat repressed economically, was that involving research and development. This was to be expected. Time was needed to allow the various firms to dispose of their existing inventories before producing new material; and research and design were incorrectly deemed of dubious value in face of the uncertainty of how long the economic stress was to persist.

However, once that on hand was disposed of, new material was required, even though only in quantities large enough to fill the few existing orders, or to have available for hoped for orders.

The new designs had to conform to the new standards of economy, both of construction and use. This led to price competition, the production of lower-priced equipment or material by one firm forcing other firms to re-design their products on new price bases, either by offering products of the same quality, designed and manufactured in a more economical manner, or by offering inferior products. The latter procedure, as experience has shown, has not always been the wise one.

One of the most reassuring signs of the day is seen in the continuance of development work — reduced and limited it is true; but continuing nevertheless. Its continuation, however circumscribed, suggests a feeling of optimism, a feeling that its fruition will occur sooner or later, perhaps not so far in the future as our present gloomy thoughts would suggest.

Increased Standardization

One other very important feature of the economic adjustment is the necessary implication of standardization found in the notion of cost-reduction. Standardization leads to fewer kinds of component parts of equipment; fewer variations of technique in processes; the application of the methods of mass-production; the improvement of the facility of replacing parts, repairing machines, and extending service. In fine, it affords all branches of the industry the opportunity of traveling the same road in concert, avoiding the dissension and expense that occurs when everyone pulls in conflicting directions.

Summary

To sum up, though our prophesy may seem disappointing in its great generality and lack of spectacular optimism, evidences of improvement are slowly coming to light throughout the industry. The acute stage of the economic plague seems to be past. The general paralysis seems to be breaking up into smaller localized areas, great in number at present, but giving promise of a steady decrease with time. Recovery will not be very rapid at first, yet this perhaps is fortunate since it will provide sufficient time in which to make the requisite adjustments, and allow the amending of these adjustments according to the changing conditions.

There is justification for optimism —a sober, orderly optimism—one that expects good results from good work; but not one that expects something for nothing, as was prevalent a few years ago.

Good News

THAT HAS SCOOPED THE NATION!

High fidelity all AC operated equipment available for theatres of all sizes on three year deferred payment plan. with small down payment and weekly payments, as follows:

Standard Super Size (2500 to 4000 seats)	$46.67 per week
Standard Large Size (1400 to 2500 seats)	$35.72 per week
Standard Small Size (600 to 1400 seats)	$24.10 per week
Special Size (Up to 600 seats)	$15.02 per week

Trade-in allowance on old equipment will further reduce above weekly payments!

Above payments include cost of periodical scheduled service.

NOW... you can buy outright the world's best sound equipment!

NO MORE LEASING — NO MORE PROLONGED CONTRACT SERVICE!

It's the sensation of the industry — the RCA Victor Company's revolutionary new policy which provides for outright sale, on liberal terms, of the new Photophone High Fidelity sound-reproducing apparatus. At one stroke we have eliminated for motion picture exhibitors the outmoded leasing system and prolonged contract service. We have provided for minimum contract service on deferred payments, and a liberal trade-in allowance on old equipment... No wonder exhibitors from all parts of the country have been vastly interested... have sent eagerly to the company's home office and to its sales representatives for further details. We'll be glad to send you full facts on this new plan — study the deferred payment listings given below — then get in touch with us or our representatives!

PHOTOPHONE DIVISION

RCA Victor Co., Inc.

CAMDEN, N. J.

Branches in all Principal Cities of the World

Considerations Regarding the Double Reel

WHEN the Academy Standard Release Print Make-up was put into effect November 1, 1930, no specification was included as to the length of the reel. The Standard Release Print represented the first systematic effort to provide projectionists with an accurate leader which would be the same for all companies. At that time it was hoped that with the leaders made standard and with a national campaign of education, projectionists would stop mutilating the ends of reels, stop scratching on their own personal cues and would make all change-overs perfectly. That was two years ago.

In 1930 some projectionists were doubling up reels and when they did it made trouble for everybody as combination disc and movietone prints were being used. However, the use of disc prints kept down the amount of doubling and the principal problem at that time was to get the companies to use uniform leaders and take away any excuse for each projectionist to mark his own cues to fit the speed of his machines.

The Standard Release Print proved to be correct from an engineering standpoint, it made perfect change-overs possible without rehearsal when it was maintained and used and it did bring uniformity in leader make-up among every company in the industry.

The Present Problem

However, as the amount of sound-on-film increased, projectionists grew careless about keeping the prints up to the exact length. During the era of musical pictures many reels of less than 500 feet were distributed because of editorial difficulties. First class theatres adopted the practice of splicing two reels together in order to give smoother change-overs. Other theatres followed the practice because the projectionists thought it gave a better show or because the longer reels made their work easier.

In addition, more and more theatres cut down to one projectionist. It is not quite but almost a physical impossibility for one projectionist to run a smooth sound show and keep the reels in the lengths they come from the exchange.

As a result of all these circumstances, the exchanges, the theatre circuits, the unions and the producing companies have all been completely unable to stop doubling, although they have all tried and some companies spent tens of thousands of dollars fighting the practice before giving up.

The present situation is well known to every projectionist. The studios are cutting, printing and distributing reels of an average length of about 850 feet. Each reel has a Standard Leader. When these prints get to the theatres, the projectionist puts reels one and two together, three and four and so on. Before he returns the print to the exchange he more or less puts the leaders back on again, cutting off more frames in the process. Directly or indirectly the theatres pay him for the time he takes to mount and separate these reels. The exchange then either makes some attempt to maintain the print with replacements or just checks the splices and sends it on to another theatre where the process is repeated.

Proposed Solution

At the last meeting of the Research Council, this subcommittee was asked to try to find some practical solution to the problem which has been steadily growing and not only costs large sums of money every year but seriously affects the exhibition of the picture.

After consideration, the subcommittee now proposes that the industry make a serious investigation of the possibility of releasing all features on larger reels. The size proposed is 13½ inches in diameter with a four inch hub. This reel will carry a maximum of 1700 feet but in actual practice the reels as released will average a little less than 1100 feet just the same as now with a maximum of 100 feet they average a little less than 850 feet per reel.

As far as the subcommittee has gone it may be believed that the annual saving will repay the costs of the changes in equipment in a comparatively short time and that a longer reel length would represent a big economy to the industry.

Advantages of Longer Reel

In the theatres the longer reels should logically receive a hearty welcome since projectionists have been insisting on doubling up. Distribution on 13½ inch reels would effectively and positively stop doubling of features. Projectionists would not attempt to put 3,000 feet and upwards in the projectors and would not have any justification for doing so.

A reel of about 1700 feet would be of great advantage in cutting. At the present more features are released in eight reels than any other length. The proportion is about five eight reel features to four of seven reels, three of nine reels and one each of six and ten reels. This estimate is based on a survey of the last twenty releases from the six largest studios.

The effect of a 1700 foot reel would be to not quite cut the number of reels in half. In general, features now requiring eight reels would require five reels on the new length, features now requiring seven reels would require four on the new length and so on.

This would mean that the cutters would have to find only three and four change-overs per feature instead of six, seven or eight as at present. In addition to this, they would have an average of well over 200 feet leeway in which to find change-over points in comparison with the something over 100 feet average leeway per reel that they have now.

Considerations Involved

This longer reel proposal may or may not be the final solution to the problem, however. Even if all the mechanical difficulties are overcome, any change will cost some money.

As studio operations are carried on in short lengths, the longer release reel would have virtually no effect of any kind during production.

In the laboratories a longer reel would cause no difficulties that could not be overcome by minor changes in manufacturing methods. It is assumed that positive raw stock could be secured from the film companies in 2,000 foot lengths at no increase in cost per foot. The cans furnished with the raw stock could thus be used for the prints the same way the present cans are used.

In the exchanges the principal cost would be the cost of buying a large number of new shipping cases. There would not be a complete replacement outlay as the change would require six months or more, but this would be the largest single cost of making the change to a new reel size.

The problem of the gearing of rewinds in the exchanges has not yet been studied in detail. A number of tests have been made and it is found that the increased weight of a big reel makes harder work for the girls who do the inspecting in the exchanges. How much this is offset by the reduced number of reels and whether a change in the gearing of the rewinds would solve the difficulty remains to be determined.

The storage vaults of exchanges would have to be altered over a period of months and this would be a direct expense. However these vaults

(*Continued on page* 27)

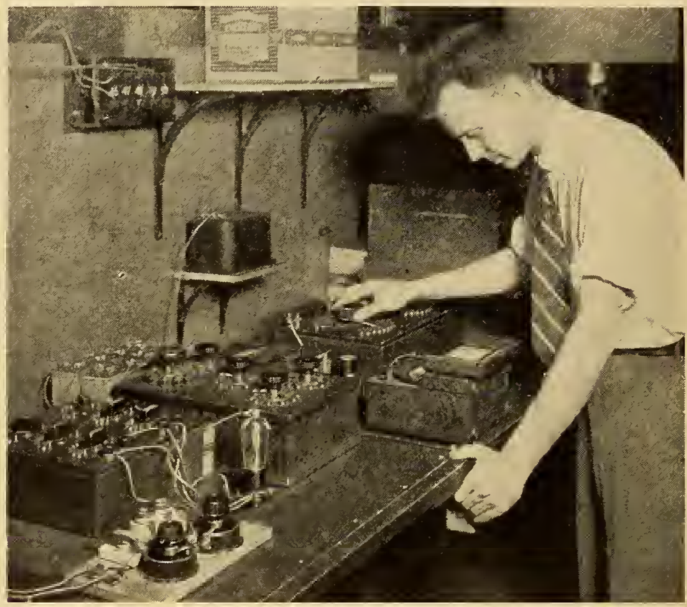
Reducing Hum in the Vacuum Tube

By J. O. McNALLY*

WHEN the filament of a vacuum tube carries an alternating current, disturbance currents of the frequencies of the power supply and its harmonics are found in the plate circuit. In voice frequency amplifiers, with sufficient gain following a vacuum tube so operated these disturbance currents produce an undesirable or even intolerable hum in the amplifier output. In tubes where the electron emission is obtained directly from the filament they are so great that such tubes can be employed only in amplifiers giving very low gains. Tubes with indirectly heated, or equipotential type, cathodes may be employed for certain radio receiver and general amplifier uses, although they cannot be employed in the early stages of high-gain amplifiers. To provide for the need of an all a-c operated audio-frequency amplifier of high gain, such as are used in public address and announcing systems, sound picture projection, and speech input equipment for radio broadcasting, the Laboratories have developed a low-hum tube known as the Western Electric No. 262-A vacuum tube.

Sources of Disturbance

Before undertaking the direct development of a low-hum tube, it was necessary to study the various ways by which disturbances enter the plate circuit, and to evaluate the contributions from each source. Equipment was assembled with which it was possible to measure separately the disturbance currents of different frequencies. Output currents as much as 120 db below one milliampere, or .001 microampere, could be measured with satisfactory accuracy. With this measuring equipment available, numerous experimental tubes of the indirectly-heated-cathode type were made and tested. From the results it was found that disturbance currents are introduced into the plate circuit in three ways: through the electric field due to the potential of the heater, through the magnetic field due to the current flowing through the heater, and through the resistance and capacitance between heater and grid, and heater and plate. Disturbances introduced through induction between parts of the circuit external to the tube are not considered because they are not a part of the tube problem.


Measuring disturbance currents in a vacuum tube

Importance of Shielding

The electric field due to the potential of the cathode heater acts on the plate current in a manner similar to that of the field of the grid. Since the electric field due to the filament varies with the frequency of the heater supply, a corresponding disturbance current is introduced into the plate circuit. The space between cathode and plate in any indirectly heated cathode tube is partially shielded from the electric field of the heater by the cathode cylinder. Below the cathode cylinder, however, there is an unshielded section of heater conductor. Experimental tubes were made therefore in which various forms of shielding were applied to this lower section. It was found that commercially practical amounts of shielding would reduce the disturbance from this source. In some of the experimental tubes the disturbance current produced by the electric field in shielded tubes was only about a hundreth of that from similar tubes not shielded.

The shield employed in the 262-A tube may be seen in Figure 1. It is in the form of a flattened bell covering the section of the heater wires below the cathode cylinder, and is supported by two short mount wires projecting upward from the glass press. Although not in contact with the cathode cylinder, it is connected to it electrically by a small wire.

A component of the disturbance current in the plate circuit arises from a deflection of the electron stream from cathode to plate — and a consequent reduction in current — by the magnetic field produced by current flowing in the heater conductor. These reductions in plate current occur twice for every cycle of heating current, and thus produce a double frequency component—120 cycle for the usual 60 cycle supply—in the output. If, because of possible asymmetries in the tube, the two reductions of one cycle of heater current are unequal, a fundamental or 60 cycle component is present. The level of such a fundamental output is generally less than that of the second harmonic, and because the human ear is 18 or 20 db less sensitive at 60 cycles than at 120, the disturbance of fundamental frequency due to the magnetic field usually is relatively unimportant.

High-Voltage Filament

In the 262-A tube the effects of the magnetic field of the heater have been reduced by employing a filament of comparatively high voltage, and thus low current, and by arranging it in a closely spaced "U" so that the field due to the current passing up one side of the "U" partially counteracts that due to the current flowing down the other side. The heater conductor is wound in a spiral and then threaded up and back through two longitudinal holes in a small ceramic cylinder. The two holes are made as close together as is mechanically possible so that the neutralization of the field due to current in one leg by that due to current in the other will be as great as possible. This ceramic cylinder is mounted within the nickel cathode which is coated with the thermionically active material. The heater is operated at ten volts and .32 amperes, appreciably less current than is normally used for tubes of this class, and the combined effect of the reduction in current and the arrangement of the filament is to minimize the disturbance currents due to magnetic fields.

---

* Vacuum Tube Development. Bell Telephone Laboratories.

Interelectrode Disturbance

The third form of disturbance current occurs because of the conductance and capacitance between heater and grid, and heater and plate. The effect may be better understood by reference to Figure 2, where the resistance and capacity between heater and grid, and heater and plate are shown in dotted lines. The heater voltage causes a current to flow through the impendance Zg, of the grid circuit, and through the capacity C^1 and resistance r^1 in parallel, back to the other side of the heater. The voltage drop across Zg due to this current appears on the grid of the tube and produces a corresponding current in the plate circuit. In a similar way the resistance and capacity between the heater and plate are responsible for a disturbance current entering the plate circuit directly. In the actual operation of these tubes, the cathode — instead of being connected to one end of the heater winding — is connected effectively to the midpoint Under these conditions capacities and resistances exist between both ends of the heater, and the grid and plate, but the action is essentially the same.

To reduce the disturbance currents introduced in this manner, the grid-heater conductance and capacitance has been made lower than for the usual indirectly heated tubes. This reduction has been brought about by two lavite blocks, evident in Figure 1, and in making connection to the grid through the top of the bulb. In this way both the capacity and the conductance between heater and grid leads, usually existing in the common glass supporting press, have been eliminated. The only effective leakage path over glass in the new tube is down the stem and over the entire length of the bulb. This resistance is held greater than 100,000 megohms, and the grid to heater capacity is only about a thousandth of that of the more used types of indirectly heated cathode tubes. Such values permit the use of resistances of several megohms in the grid circuit without materially increasing the disturbance output.

Deposit from Cathode

Plate to heater capacities are not sufficiently large to contribute materially to the disturbance outputs, and insulation leakage between plate and heater sufficient to cause appreciable current is prevented by the electrostatic shield already described. This shield bells out over the glass press where the heater leads enter it, and prevents the deposition of material vaporized from the hot surface of the acthode. It is this deposited material that usually forms the conducting path between plate and heater support wires.

Results

The extent to which disturbance currents have been reduced in the new tube is shown in Figure 3. Here the distribution of the disturbance outputs is given for a large number of 262-A tubes picked at random from the Tube Shop production. The abscissas represent the disturbance currents in decibels below one milliampere, and the ordinates the percentage

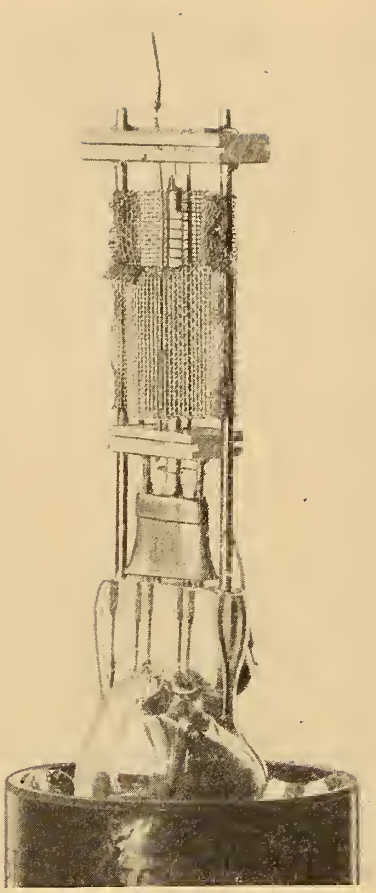


FIG. 1—*Assembled 262-A tube without bulb and with part of plate cut away to show the grid construction.*

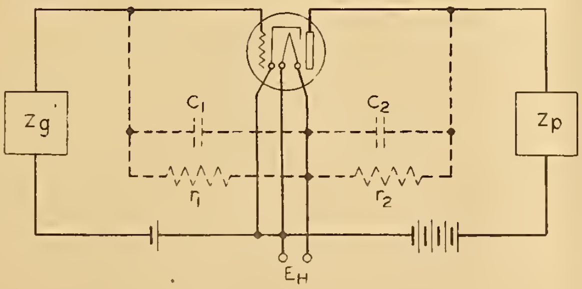


FIG. 2—*Possible disturbance current in a vacuum tube flow from the heater to plate and grid through the interelectrode capacitance and conductance.*

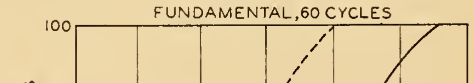
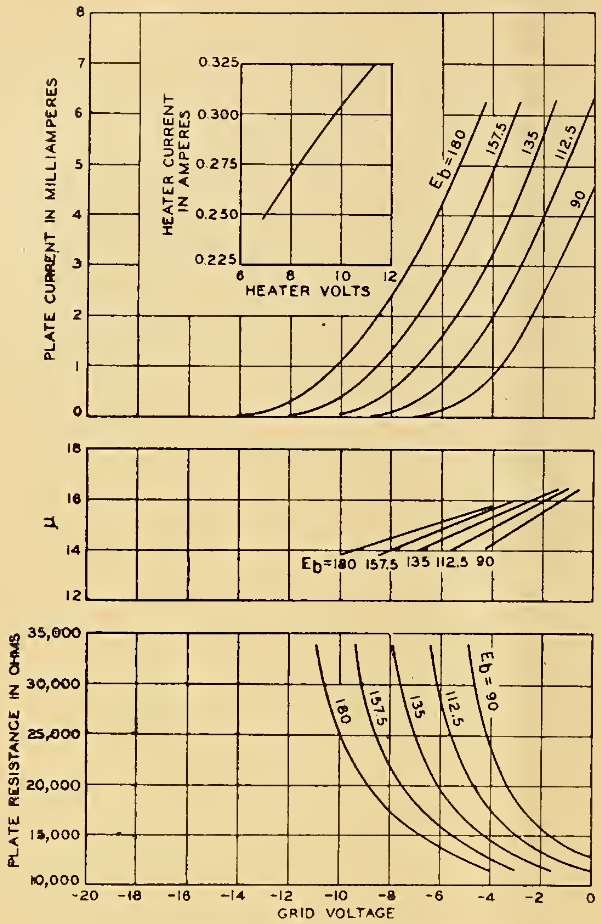


FIG. 3—*Distribution curves for disturbance currents at 60 cycles, above, and 120 cycles, below.*



Characteristics of the 262-A Vacuum Tube.

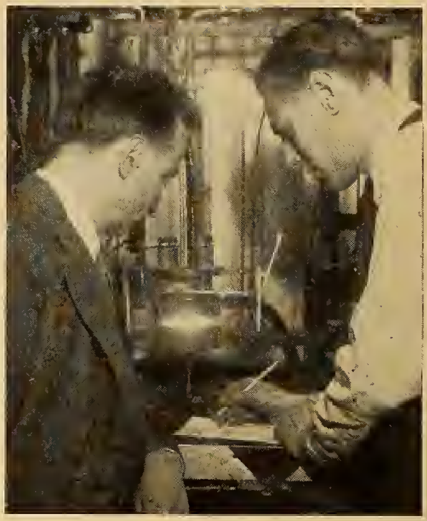
of the total number of tubes that had disturbance outputs below the abscissa value for any corresponding point of the curve. For these tests the cathode was effectively connected to the midpoint of the heater. It may be noted from the curves that for the 60 cycle of fundamental output, one half of the tubes had disturbances not less than 110 db below one milliampere, and for the 120 cycle output, not less than 112 db below. Dotted curves show the corresponding data for the 244-A tube. The disturbances for the 262-A tube are distinctly less—amounting to 30 db for the second harmonic.

In addition to the disturbance currents discussed here, there are certain low level sources of noise, such as the shot effect, and the thermal noises due to the resistances. The level of these unavoidable disturbances forms a natural lower limit by which other disturbances may be judged. Measurements made of disturbance currents in the 262-A tube due to these causes show them to be from 118 to 127 db below 1 milliampere for the shot effect, and about 105 db for the thermal noise with 2.0 megohms in the grid circuit. Disturbance currents in the 262-A tube due to the alternating current supply of the heater are somewhat greater than the shot effect and slightly less than the thermal noise. They have thus been reduced until they no longer exist as factors limiting the application of the tube.

"The Standard of Excellence
the World over
for over 75 years"
NORIS CARBONS

NEW MERCURY-ARC CONTROL

Dr. Joseph Slepian and Leon R. Ludwig of the Westinghouse Research Laboratories have developed a revolutionary method of controlling mercury-arc devices which is more positive and many times faster in action than methods now in use. The arc can be started 60 times a second at any point on the voltage wave, and since there is no grid to be protected from heating but merely a carborundum-pencil dipping in the mercury pool, large currents can be controlled just as easily as small ones. The small laboratory specimen of the new "Ignitron" tube illustrated is carrying 60 amperes at 185 volts d-c. with only 0.15 average amperes and 30 watts loss in the control element ("ingniter").



The secret of the Slepian-Ludwig control lies in a high resistance rod, partly immersed in the mercury pool, which when energized starts an arc cathode. For ⅛" resistor rod dipping ¼" below the surface of the mercury, tests showed the minimum voltage for starting the arc was about 130 volts; a sudden application of 250 volts started the arc in less than 5 micro-seconds. During tests the starter worked equally well in solidified tin, proving that its operation is independent of the degree of immersion of the rod and that it does not depend upon an actual breaking of contact with the mercury. Based on careful experiments, the extraordinary performance of the "igniter" is belived to be due to conditions at the rod-mercury junction which is found similar to the last contact point of separating contacts. Details of the development of this form of control promises to be one of the most interesting papers to be presented at the forthcoming national A.I.E.E. meeting in New York.

Another "Low" Mark

The average theatre is open to the public 52.8 hours per week and the lost playing time per theatre, due to emergencies, is .088 minutes per week.

The above averages are the result of a survey made by the Operating Planning Division of Electrical Research Products in the course of weekly duties and covers almost 5,000 theatres or, approximately 90 per cent of the theatres using Western Electric equipment.

Both the highest and the lowest averages of show hours occur within the Northeastern Division, varying from a high of 81.9 show hours per week among 129 theatres in Manhattan to the low of 40.6 hours in 122 theatres of the Scranton, Pa. district.

THE DOUBLE REEL

(*Continued from page* 23)

for the most part simply contain bolted iron frames and the changes in spacing could be made very cheaply.

Projectors, Fire Laws, etc.

All Simplex, Powers and other standard makes of projectors will carry the 13½ inch reel. There may be some few projectors still in use that will not, and data on this point is now being collected. Power rewinds, storage racks and other projection room equipment is either already suitable or would require very minor changes.

In several cities and states the present fire laws limit the length of reels to 1000 feet. These laws are being violated now but if any general change were made by the industry it would be necessary to secure uniform legislation.

Disc release is another important factor that will have to be taken into account.

While there are very few exclusively disc accounts left, several of the companies still undertake to provide for them. Either these theatres would have to be converted to use movietone prints or records would have to be made of such pitch and size that they could play against the longer length of film.

Foreign Release

The effect of a longer reel unit on foreign release is a subject upon which virtually no information has been available in Hollywood but one on which the alternatives are comparatively simple. Information will have to be secured on whether European projectors and related equipment will carry a 13½ inch reel. If they will, there is no serious problem. If not, it may be necessary to determine two sets of change-over points for every feature that is released abroad, one for the American reel length, the other for the present thousand foot reels until such time as the longer length could be standardized throughout the world.

Rear Projection Discussion for S.M.P.E. Spring Meeting

Rear screen projection, which may be the solution of several problems inherent in the time honored practice of locating the projecting room somewhere in the vicinity of the theatre's rafters, will be among the discussions at the spring meeting of the Society of Motion Picture Engineers. Interest in this development has been furthered by the success of the Trans-Lux system.

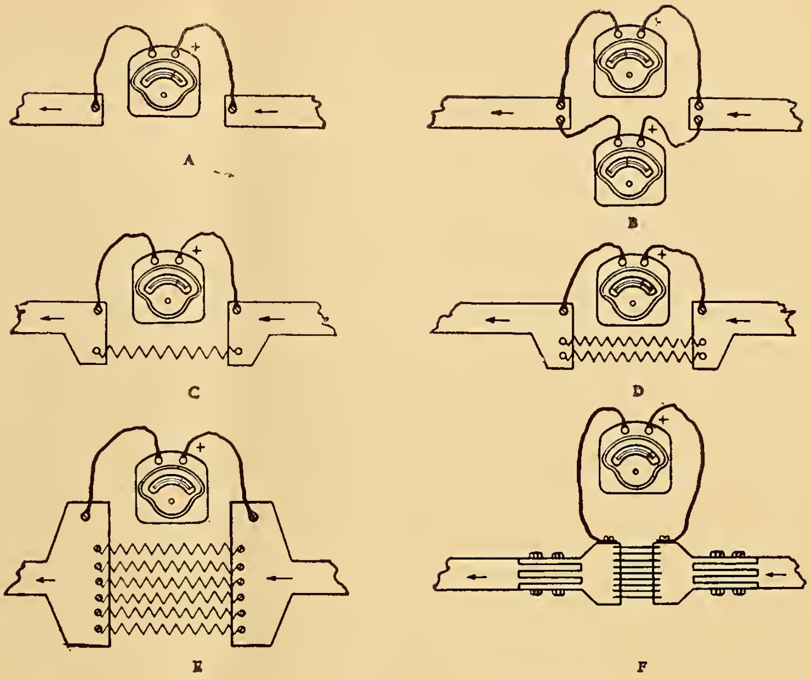


FIG. 7—*Principle and Evolution of the Multiple Blade Shunt.*

D. C. MEASURING INSTRUMENTS

(*Continued from page* 14)

is equal to that of the instrument; then, of course, half of the current will go through this shunt, and all we have to do is to multiply the indication of the instrument by 2 to determine the total current.

If we carried this scheme further and added another shunt, as in Sub-D, it follows that (the three circuits being alike) the instrument indication would represent 1/3 of the total current.

We might continue in this manner indefinitely, adding any number of shunts (Sub-E) adjusted so that each one had the same resistance, but why should we use such a clumsy method when all that is necessary is to consider all of these shunts as a unit and determine its resistance as a unit, no matter how many separate conductors it may be made of. It will not affect the result if these are not alike in size or resistance, provided each has sufficient dimensions to carry its share of the current; and if we firmly solder all of them to a suitable block and provide terminals for connecting the instrument, then instead of having a number of individual shunts, we have a single multiple blade shunt, (Sub-F). And if we find that the total shunt resistance is ½, 1/10, 1/100, 1/1000 or any other fraction of the instrument resistance, is it not easy to decide what part of the total current will flow through the instrument and calculate what the total current actually will be?

Or, to be in accord with these time-saving, labor-saving days, suppose the manufacturer does the calculating for you, once and for all, and puts the shunt inside of the instrument or makes it detachable — as you prefer — and calibrates the scale so that it will correctly indicate the total current, why, then, you have a modern direct current ammeter.

The current which a shunt has to carry is what chiefly determines its size, because it is evident that enough metal must be used to prevent the shunt from becoming overheated; and at the same time the resistance must be high enough to allow a suitable portion of the current to flow through the movable coil of the instrument and although the temperature of the shunt may be raised by the current, the resistance of the shunt must not increase appreciably in order that the results obtained may be correct within a wide range of temperature. To accomplish this, special alloys are used.

Next month Mr. Wolfers will describe the principle and operation of Alternating Current Measuring Instruments.

NEW ADDRESS

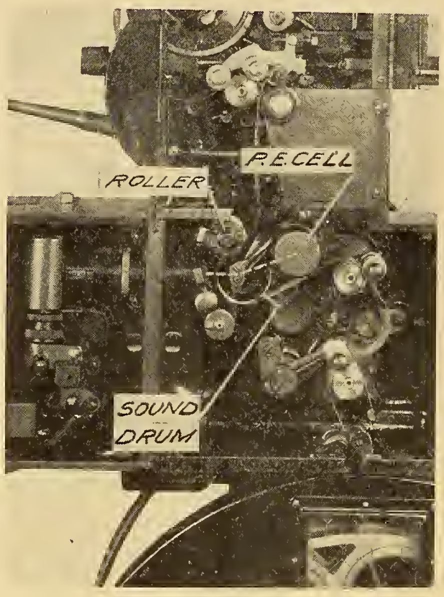
Our readers are requested to note that the offices of the MOTION PICTURE PROJECTIONIST are now at 381 Fourth Avenue, New York City and to address future communications to the magazine accordingly.

The New RCA Sound Head

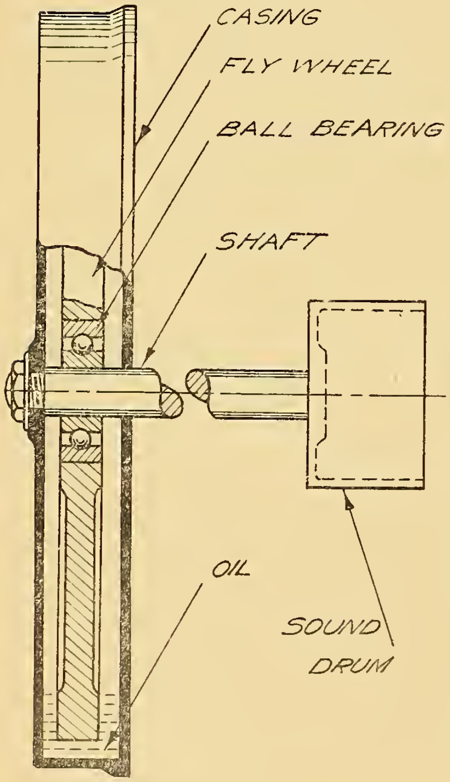
TO take full advantage of the extended frequency range and minimizing of ground noise made possible by improved recording, a new soundhead has been developed by RCA-Victor Company. The new sound head is designed to eliminate flutter and rasp due to the irregular motion of the film when scanned while being pulled through friction gates or equivalent devices by sprockets engaging the perforations.

Continuous research on this problem has produced a new mechanism for moving the film past the light beam. While the film is being scanned, it moves over a steel drum. The sound track overlaps the outer edge of the drum, allowing passage of the beam to the photo electric cell. The greater part of the film, however, is held in contact with the surface of the drum by a roller of compressed felt. The flanges of this roller prevent any lateral movement or "weave" of the film as it moves over the drum.

The superiority of this means over previous devices is evident, since apart from minimizing of friction and strain on the film, it makes possible the replacing of the sound gate by a more heavily constructed unit which under all conditions will remain in correct alignment with the light beam. Moving with the drum, the film becomes, in effect, part of a system having mass, it being thereby possible to control the uniformity of its motion independent of the rest of the mechanism.



Right hand side of new sound head showing path of film over sound drum. The Rotary Stabilizer being on the other side of machine is not seen in this photograph. Dotted line shows how light beam is offset to P.E. Cell.



Sectional view of Rotary Stabilizer. This sketch was made to show the operation of the mechanism and is only approximately to scale.

The Rotary Stabalizer

Uniform rotation of the sound drum is insured by the Rotary Stabilizer. The other end of the shaft on which the drum is mounted carries a cylindrical metal casing. Within this casing is a flywheel revolving on a ball bearing on the same shaft. The casing is filled with a thick oil. This oil due to its viscosity, forms a flexible link between the casing and the fly-wheel, so that normally the sound drum, casing and fly-wheel rotate as one.

However, should any irregularity of rotation be imparted to the sound drum by the film, due to uneveness of surface at some point in the latter. this variation would also be transmitted to the casing at the other end of the shaft. The vibration would spend itself in the oil in the casing and the fly-wheel continuing at the same speed, due to its greater momentum and the fact that it revolves independently of the shaft, would quickly bring the rotation of the unit back to normal.

Other Refinements

In this new sound head are other features designed to reduce maintainance costs and insure reliable performance.

The motor which drives the projector and the sound head is mounted as an integral part of the latter and drives through a worm gear cut on the armature shaft. This eliminates exterior high speed belts or chains, and results in very quiet operation. The gearing runs in an oil bath, an oil seal on the shaft preventing leakage when the oil is above that point. All running bearings are of the ball type.

A hand wheel on the outer end of the motor shaft provides an easy means for the projectionist to turn the mechanism for checking threading, etc. Threading is extremely simple and there is ample room to work during threading operations.

The optical system is oil proof and the exterior lenses of the system are easily accessible for cleaning. The end of the optical barrel is at a greater distance from the surface of the sound than it was from the sound gate. This insures against the possibility of anything becoming jammed between the barrel and the film.

This new soundhead, it is claimed, makes possible the realization of the improved reproduction to be expected with the use of high fidelity or wide range recorded film. It is designed only for Simplex projectors.

Griffin on S.M.P.E. Board

Herbert Griffin, of the International Projector Corporation, has been appointed a member of the Board of Governors of the Society of Motion Picture Engineers to fill the vacancy created by the resignation of L. C. Porter of the General Electric Company.

Mr. Griffin has long been one of the most active members of the Society and has rendered valuable services in a number of capacities. Mr. Porter's resignation resulted from a gradual disassociation from the motion picture industry due to changes in the nature of his work with General Electric. He has been a member of the Society since 1917 and served as President during 1922, 1923 and 1929.

Arthur Smith, Projectionist

By ROBERT J. MARCY

As we recall the popular accounts of the careers of men on whom the spotlight of publicity has been focussed from time to time, it seems that not a few of them "sky-rocketed to fame". In racking our brains for some appropriate opening for this story on the career of Arthur Smith, it has occurred to us that we might begin by saying that the well known projectionist "parachuted to prominence". This, besides sounding dramatic, would mean more than the other phrase, for although fame and prominence may not have sunk to quite so low a level as everything else, we fear that since the incident in Wall Street a few years ago the word "skyrocket" is no longer intelligible.

However, as a matter of fact, Arthur's aerial activities although persued for two years, were more a means of earning a living than a reputation as one of the country's leading projectionists. So, for the present, let us leave the parachutes, royalty and other interesting material appearing in Mr. Smith's life and begin from the starting point of most lives, the subject's birth, which took place in Pittsfield, Massachusetts on May 26th, 1884.

We all of us remember that period in our early youth when our fancy chose some renowned figure and resolved to follow in his footsteps — that age when we had not yet done enough stepping of our own to discover what a harsh place this world is outside. Arthur's hero was the great Stienmetz and he didn't have to rummage through the pages of a history book to come upon him, since the wizard of alternating current worked for the Stanley Electric Company in his home town. After finishing high school, Arthur enrolled for an electrical course with the same Company, which was later to become the General Electric. Though Smith later forsook electrical engineering for motion picture projection, the thorough practical training he received in the Stanley plant has many times proved a valuable background. To fill in time during the vacation following the third year of his course, Arthur took a job as assistant to the projectionist in a theatre newly opened in the town. Before the end of the summer, a competing house in the town had offered him a job as projectionist. Smith sent for his younger brother Walter and soon the projection force of Pittsfield's "Newest and Finest" theatre consisted of two members of the Smith family.

This was back in 1904, in the days when right arms were the prime movers of projection mechanisms, a 25 ampere a.c. arc was considered high intensity illumination and theatre managers were known to offer jobs to projectionists. In projection, young Smith found an opportunity to indulge his love for practical science while making a living. But when a few months after settling down to his second job, the manager of a Canadian theatre who happened to be passing through Pittsfield offered him another, Arthur accepted it. Though this initial excursion took Smith only across the border to London, Ontario, it was the first indication of a wanderlust which later was to be many times gratified.

Having spent a year in the Canadian town, Smith decided he would see what the Big City had to offer to projectionists, and so he set a course for New York. But as happens to so many of us who come to this proving ground of ambitions, Arthur erred a trifle in his navigation so that instead of locating himself immediately as chief projectionist in one of Broadway's film palaces, he found himself eventually working as an operator for a "store show" on Eighth Avenue.

A store show was a movie shown in a store with an admission of one nickel and a program of as many shows a day as possible. Needless to say, this proved to be a very educational occupation, especially since the projection equipment was usually in the last stages of disrepair.

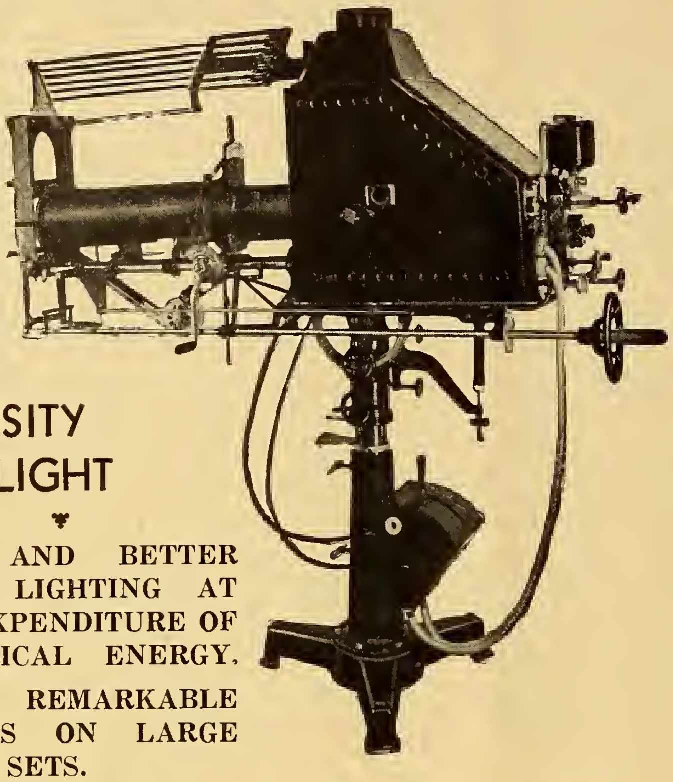
After store shows had lost their charm for Arthur, he toured the country for three years working as an itinerant operator while seeing America first. In Troy, N. Y. after a disagreement with the theatre manager, Smith found himself minus a job. Wandering downtown, he finally arrived at a tent show playing a three-day stand in the up-state town. Arthur instinctively hit the manager for a job and the next day found himself canvas man with the Walter L. Main Shows.

His job was selling tickets for the Grand Concert which always followed the main performance. When the tickets weren't selling very well, Arthur relied on baloon jumping to make up the difference in his earnings, and it is here that we reach the aviation period of this projectionist's career. The feature of every tent show at that time was a jump from a hot air baloon. Since there was no radio advertising in those days, the big bag was inflated with hot air generated by a charcoal fire. When it had been filled, the daring aerialist would hang from a trapeze as it soared upward. When the actor was high enough to suit the dramatic sense of the manager, a signal would be given to him to cut away his parachute and let go. Usually, the parachute opened. If it didn't, the actor never discovered why. Smith must have been unusually careful - or perhaps the Fates foresaw the Radio City project. At any rate, although he kept at parachute jumping for two years, Arthur is still intact. This form of occupation paid him at the rate of twenty-five dollars per jump, which was not so much as it sounds, for besides risking his life, for this figure, he was required to maintain his own balloon, parachute and other equipment.

The year 1907 saw Smith back in New York, and for two years he worked in the same theatre - at that time a record of stability for him. But the urge to travel was not to be denied. This time England called and after working his way accross on a cattle boat, he arrived in London and obtained a position with Cinimacolor, the first company to attempt a color film. At the Scala theatre he operated the first commercial Cinimacolor. After working a year with the firm in England, Smith was sent back to the United States to make installations for America Cinimacolor. One of his first installations was at the Regent, at 116th Street, in New York, where a Mr. Rothafel was manager. This was Smith's first meeting with Roxy.

When Roxy saw the first performance of a Cinimacolor film, he was impressed by the excellence of the projection and the smooth operation of the equipment. It must be remembered that the motor driven projector was then a new thing, its use previously having been banned by the in-

(*Continued on page* 31)



HIGH INTENSITY SPOTLIGHT

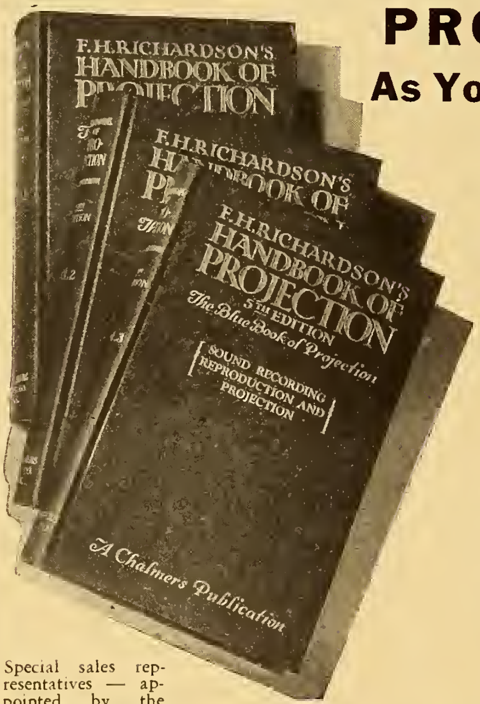
MORE AND BETTER STAGE LIGHTING AT LESS EXPENDITURE OF ELECTRICAL ENERGY.

MOST REMARKABLE RESULTS ON LARGE STAGE SETS.

HALL & CONNOLLY, INC.

24 Van Dam Street New York, N. Y.

H & C INC.


F.H.RICHARDSON'S HANDBOOK OF PROJECTION
5TH EDITION
The Blue Book of Projection
SOUND RECORDING REPRODUCTION AND PROJECTION
A Chalmers Publication

PROJECTION

As You Must Know It

This 5th edition HANDBOOK OF PROJECTION by F. H. Richardson is known the country over. It has been the means of making thousands of projectionists masters of their profession. Remember, Richardson gave the "operators" of 1910 the first projection manual ever written.

Now 3 Volumes

Over 1,400 pages of the most vital kind of information. Each volume carries the special Richardson question and answer index—the greatest feature any projectionist could wish to have.

If your future is linked with projection make it brighter and securer by owning and studying this finest of projection libraries.

The complete set of three volumes mailed to your door upon receipt of check or money order for $10.25.

Special sales representatives — appointed by the Chalmers Publishing Company, publishers of the Handbook on Projection - - -

MANCALL BOOK COMPANY
381 Fourth Ave. New York City

GERMAN BOOK ON SOUND RECORDING

We have been requested to comment on "Einfuehrung in die Tonphotongraphier (Introduction to Sound Photography) by J. Eggert and R. Schmidt recently published by S. Hirzel of Leipzig, Germany.

This book is a treatise on the different methods of photographic recording of sound. The subject, though covered with traditional German thoroughness, is for the most part, elementary in nature, a number of the charts included requiring but a scant knowledge of mathematics to follow.

While this book, so far as we have been able to ascertain, is available only in German, it should prove helpful to projectionists with a knowledge of that language whose interest extends to the field it covers. It must be added that the work is decidedly the best illustrated treatise on the subject that has yet come to our notice.

IMPROVED LAMP BASE

The Westinghouse Lamp Company announces a new base design for the Mazda 2000 watt, G-48 bulb projection or spotlight lamp.

This new "mechanical" base design consists of metal parts which are attached by machine. It replaces the use of cement and eliminates early deterioration of the cement from heat dissipation in high wattage lamps, thus preventing loosening of bases which can impair the position of the light center or cause short circuits.

Development of this new base design is an outgrowth of the reduction in the size of high wattage incandescent light sources. Smaller light sources mean smaller equipment and lower first costs. But, this trend to hotter operation has resulted in faster deterioration of the cement in the bases because of a greater heat dissipation. The new base design corrects this condition.

The mechanical base is simple in design, consisting of a ferrule of eraydo metal and a standard mogul base. The ferule is replaced inside the base and both are slipped over the neck of the bulb then clamped into slight indentations moulded in the glass until a tight fit is obtained. One lead-wire projects straight through the button of the base and the other is turned up into a groove along the glass neck. After the base is clamped tight the ends of the lead-wires are welded to the base.

Arthur Smith, Projectionist

(*Continued from page* 29)

surance companies who believed that if the projector had its own power, the operator would no longer give it the attention necessary for safety. Hand operated machines and the restricted amperage used in illumination resulted in flickering, poorly lighted pictures. Since Cinimacolor film was run at exactly twice the speed of the usual film, and as color film requires much more light to illuminate the projector, the projection equipment was both motor driven and powered for much higher current.

On Smith's recommendation the equipment at the Regent was revamped and imported carbons — at that time much superior to those of American manufacture — were installed. The resulting improvement in the quality of the projection was a source of no small satisfaction to Roxy, and Arthur's reputation as a projectionist with him was made.

In 1913 the Strand, Roxy's first downtown theatre opened, and at the same time Cinimacolor failed, so Art went to work for Roxy. But he was not yet ready to settle down, and in 1914 he went on the road with a "Birth of a Nation" show. This was the time of the first of the great "spectacles" which were made by that great man of pictures, D. W. Griffith. These shows were sent out with a complete set of sound effects, which were operated from behind the curtain. Griffith is credited with the first attempt to combine the picture with correct sound effects.

It was in 1915 that Smith first met the man who aside from Roxy was to be most influential in his career. At the English Opera House in Indianapolis, the manager, a friend of Arthur, was having trouble with his projection. When Smith came to town, he was asked to inspect the installation at the theatre and he did so, making several adjustments, which materially improved the quality of the picture. Among those present in the booth at the time was a tall rather unassuming man who took a keen interest in what Smith was doing. Impressed with Smith's evident knowledge of projection equipment and its use, he must have labeled him as a man to remember. At the time, however, nothing more was said, and Smith continued on his way with the show. In 1916, while in Chicago, he received a call from Griffith's office in New Work to come East and operate the premiere of the new picture "Intolerance", sometimes called the greatest film ever made. After the second week of the New York showing, Smith was made supervising projectionist of all "Intolerance" shows throughout the country. With Griffith, he opened the picture on the west coast at Clune's Auditorium in Los Angeles, then the largest theatre on the west coast. He then opened the show successively at San Francisco, Chicago, Minneapolis and Philadelphia.

At Philadelphia he received a wire to report to the home office at once. At New York, he learned that he was to leave in three days with Griffith for England. Circumstances prevent the sailing, however, and luckily so, for the boat on which they were to sail was torpedoed and sank in mid Atlantic. Several days later, the party sailed on the "Baltic" and after a number of submarine alarms, landed in Liverpool. In the spring of 1917, the first exhibition of "Intolerance" was given at the Drury Lane Theatre in London, with Smith in the projection booth. After an eventful run in London, which included a private exhibition for King George, Art supervised the showing and construction of sound effects throughout England, and Ireland. An interesting sidelight in the exhibition of this picture is that although the picture was intended to be shown in France, owing to the episode of the Huguenot Massacre in the story, the picture was never publicly shown in that country.

Shortly after America's entrance in the war, General Pershing and his staff landed in England. This was an event of great news value, but due to the strict censorship of the British War Board, no pictures of any kind were allowed out of the country. Griffith, however, always the master showman, managed to take shots of the landing, and Smith was sent back to America with the 500 feet of film around his waist. Friends remarked after that, that fellow Arthur was always wrapped in his job! This was one of the greatest scoops ever scored by a news film. Smith returned at once to England and later went to France, where he assisted Griffith in filming his great war epic, "Hearts of the World".

In the fall of 1917 Art returned to America and enlisted. He was assigned to the Department of Public Information and shipped back to Europe, where he traveled through all the Allied territory showing propaganda films.

Shortly after the Armistice, he was sent to Coblenz to establish a film distribution center. In August 1919, he returned to this country and was demobolized. This was at the time that the Capitol, under the direction of Major Bowes was opening. Arthur applied for the position of chief projectionist, and got it. In June 1920, after a disagreement he left the Capitol, to return to it at the request of Roxy. Shortly after he was placed in charge of projection there. Arthur has been with Roxy ever since, with the exception of a short time the latter was out of the Old Roxy on Seventh Avenue.

As chief projectionist of the Radio City, Smith has on his staff a crew of 24 men — 13 at the Music Hall and 11 at the Roxy. This includes his brother Walter who has the same job which he held at the Capitol and at the Old Roxy, that of film editor. Every new reel and every foot of feature picture show in the International Music Hall and the new Roxy passes under his eye.

Arthur has been called, not without merit, "Projectionist to the Presidents". Since Roosevelt (T.R.), Taft is the only president before whom Smith has not exhibited. Among the pictures which he has shown at the White House have been "Dante's Inferno" before Roosevelt; "The Birth of A Nation", and "Intolerance", before Wilson; "The Big Parade", before Harding and Coolidge, and "The Cockeyed World" before Hoover.

SYMMETRICAL TRACK

(*Continued from page* 16)

cle, the mask made by the shutter has been shown in proportion to the track more nearly as it appears on a typical print.

Due to our doubt about the first drawing, we did not make a comparison between the shutter track and the symmetrical track. However, the further reduction of ground noise by the symmetrical system, as seen in this comparison, is only of incidental importance. In terms of ground noise area to useful area, the superiority of both tracks is brought out by comparing them to the one in use before the comparatively recent advent of the shutter and high-fidelity systems, in which there was *no* minimizing of clear area. The chief advantage of the symmetrical track is that it permits a more simple and efficient biasing operation than that possible in the system which immediately preceded it.

THEATRE EQUIPMENT
NEW AND USED
Sound Equipment, Moving Picture Machines, Screens, Booths, Opera Chairs, Spotlights, Stereopticons, Film Cabinets, Portable Projectors, M. P. Cameras, Generator Sets, Reflecting Arc Lamps, Carbons, Tickets, Mazda Lamps and Supplies.
Projection Machines repaired and overhauled. Repair parts for all makes opera chairs. Attractive 3 x 10 ft. muslin banners, $1.50; on paper, 50 cents.
We Pay Highest Prices for Used Projection Machines, Opera Chairs, etc.
Everything for the Theatre—Write for Catalog K.
MOVIE SUPPLY CO.. 844 So. Wabash. Chicago.

Fox Looses THUNDERBOLT

IT was a great shock to many people when William Fox, pioneer of motion pictures and head of one of the greatest companies in the business, was forced to sell his interest in Fox Films and turn the company he had built up through many years to a group of outsiders, mainly Wall Street bankers. Since then the career of Fox Films and Fox Theatres Corporation is well known, first under Harley Clarke, then under a Mr. Tinker and lastly under Sidney Kent, the only true film man among the three.

Perhaps the company is now being rehabilitated. It is difficult to say because the depression is so general. But it is a fact that the Fox companies have not thrived under alien rule. But for that matter neither did they thrive toward the end of the reign of William Fox.

But back of that sudden change of ownership every one knew lay a story, a story that was as sensational as any movie because of the titanic figures and forces involved. But few knew the truth. Now at last one side has told its story.

A book has just come off the presses entitled "Upton Sinclair presents William Fox". A far better title would have been "Believe it or Not".

Fox has broadcast his story to the world. And in it Fox is the shining knight who battles on the side of (and with) the Lord against all the forces of wickedness. He loses in the end but not before he has slain many of his enemies and exposed all the rest to the scorn of the whole world. Yet when the last word is read there lingers a thought that the Fox himself is also a little stained with the blood of innocents.

Now, had Fox written this story himself not as much attention would have been paid to it. Or had he got someone else to write the story, other then its author, its fate might have been not so prominent. But, showman that he is, he went directly to the one man whose name on the book would give it point and international attention. That man is Upton Sinclair, a world renowned literary figure and publicist who is famous for his startling and unchallanged attacks on Wall Street, international bankers and Big Business.

The two of them, one with his biting and scorching pen, the other with his documents and bitter memories concocted a stirring tale which will be read from coast to coast by millions. Whether the facts be true or untrue Wall Street must answer the challange or remaining silent, stand condemned.

Nothing is concealed. Sinclair, in all his writings has always said that nothing he prints cannot be substantiated by him by documentary evidence and so this book mentions names that are famous, honored and respected which present here but a poor showing. Only Sinclair dares to publish such matters and only Fox with his reputed personal fortune of twenty millions of dollars could afford to risk big libel suits. The publication of this book is not the end of the story. The motion picture industry waits with bated breath for the answer, the form of the answer, of those whom this book rakes and ravishes.

Fox, called by Sinclair in the book sometimes as the Fox, the little Fox or just plain W. F., discloses here his many attempts to raise money (in the millions) to save his companies and how he was tricked and cheated at every turn until the bitter end when he surrendered. The field of battle is strewn with the broken promises of lawyers and financiers. Mrs. Fox plays a prominent part in the struggle but her contribution is chiefly womanly intuition or clairvoyance by which Fox is warned ahead of time of the special designs of his enemies, by which friend is picked from foe. To her chiefly is given the final credit of saving for Fox the Tri-Ergon patents by which Fox hopes finally to beat his enemies to their knees.

For some this book will make hard reading. Page after page endlessly is covered with figures in the millions of dollars. The possession of the Fox companies is what they fought for: money was their ammunition. Million dollar fees to lawyers, millions of dollars to lend and all and bonuses to banks and financial houses; millions of dollars to borrow, of it out of the fast emptying pockets of the little investor who of course lost all of it and was crushed in this battle of titans.

This alone makes a fine spectacle in these depression days. When people go hungry for lack of a dollar, millions are tossed about by these Wall Street playfellows, including The Fox.

The story cannot be adequatly covered in a few pages of review. It must be read to appreciate its full flavor. But my guess is that William Fox and Upton Sinclair have started something. This will not end with the publication of one book. It will have reverberations in many places high and low and in the end something will be done to make such affairs less possible. A large corporation, of which the true owners are thousands of American citizens, becomes a sort of public property and some agency, probably the government, will have to exercise a stewardship to protect its citizens.

This review would not be complete without some mention of the Tri-Ergon patents which seem to have been at the bottom of a great deal of the Fox's troubles. Several years back, at about the time talking pictures came into being, Fox purchased American patent rights to several of the important elements of sound production and reproduction. He purchased them from a group of Germans who already held European patents. One of these elements was the flywheel and the other the photo-electric cell. The United States patent office, according to Fox in the book, has already recognized and given him an American patent on the flywheel and he claims that the patent on the photo-electric cell will be his shortly too. Obviously the electric companies are helpless before him without these two fundamental rights, if his claim is true, and eventually Fox hopes to collect endless millions back from them in accrued but not yet recognized royalties. When and if this happens Fox, the Conqueror, will deserve another book.

Patents

Complete service:

Inventions developed. Models and drawings. Also searches.

Patents obtained by registered Patent Attorney, former patent chief of large corporation, and a successful inventor himself. Rates low for highly skilled service.

Foreign patents obtained economically through associates abroad, visited during world tour.

Sales campaigns conducted, on commissions, to market patents. Contracts drawn.

Also trade marks, designs, and copyrights.

Write for FREE ADVICE, or phone.

RAY BELMONT WHITMAN
277 PARK AVE., N. Y.
Phone: Wickersham 2-7600

THIS BOOK IS A CHALLENGE TO EVERY PROJECTIONIST IN AMERICA

More Miehling books have been sold to projectionists than any other. . . . There have been others since Miehling's book was brought out. . . and all at a higher price . . . but Miehling's still remains as the only book written by a projectionist for projectionists. . . . That is why it is so overwhelmingly popular.

In this book you will find a thorough-going explanation of the fundamentals of ALL sound equipment. Western Electric and RCA outfits of all types are fully treated as to construction, wiring, functioning and trouble-shooting. There is also a practical discussion of the most widely used independent sound equipment. Every projectionist will find his needs adequately fulfilled, both as to the theory and practice of sound operation.

NOW ONLY

$2

SOUND PROJECTION
By MIEHLING

Member of Local 306, Motion Picture Operators Union of New York City, Engineer, Designer of sound equipment and practicing projectionist.

●

519 pages . . . . Completely indexed. Fully illustrated.

Do not Delay! Fill in this coupon and forward to us at once with your remittance. Do it now!

MOTION PICTURE PROJECTIONIST
381 Fourth Ave., New York City

Send me Miehling's Sound Projection. Enclosed find remittance of $2.00.

Name..

Address..

City and State..

Position..

Theatre..

It Pays to be Critical

IN the manufacture of National Projector Carbons we are as exacting in our demands for QUALITY as the most critical exhibitor can be about the quality of his projection.

That is why you will always find it safer, more economical and more satisfactory to insist on National Projector Carbons.

There is a National Projector Carbon for every type of projection lamp.

Old Type, Low Intensity, D.C. Arcs
Low Intensity, White Flame, A.C. Arcs
Low Intensity, Reflector D.C. Arcs
High Intensity, Condenser Type, D.C. Arcs
"High-Low" Reflector Arcs
Effect Machines.

NATIONAL PROJECTOR CARBONS

. . . Sold exclusively through distributors and dealers. National Carbon Company will gladly cooperate with the producer, exhibitor machine manufacturer or projectionist on any problem involving light.

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division . Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices:
New York   Pittsburgh   Chicago   San Francisco

21 5

LIBRARY OF CONGRESS
0 007 552 329 4